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FOUNDRY TRADE JOURNAL

EST. 1902

WITH WHICH IS INCORPORATED THE IRON AND STEEL TRADES JOURNAL

VOL. 99
No. 2049
Registered at the G.P.O. as a Newspaper

DECEMBER 8, 1955
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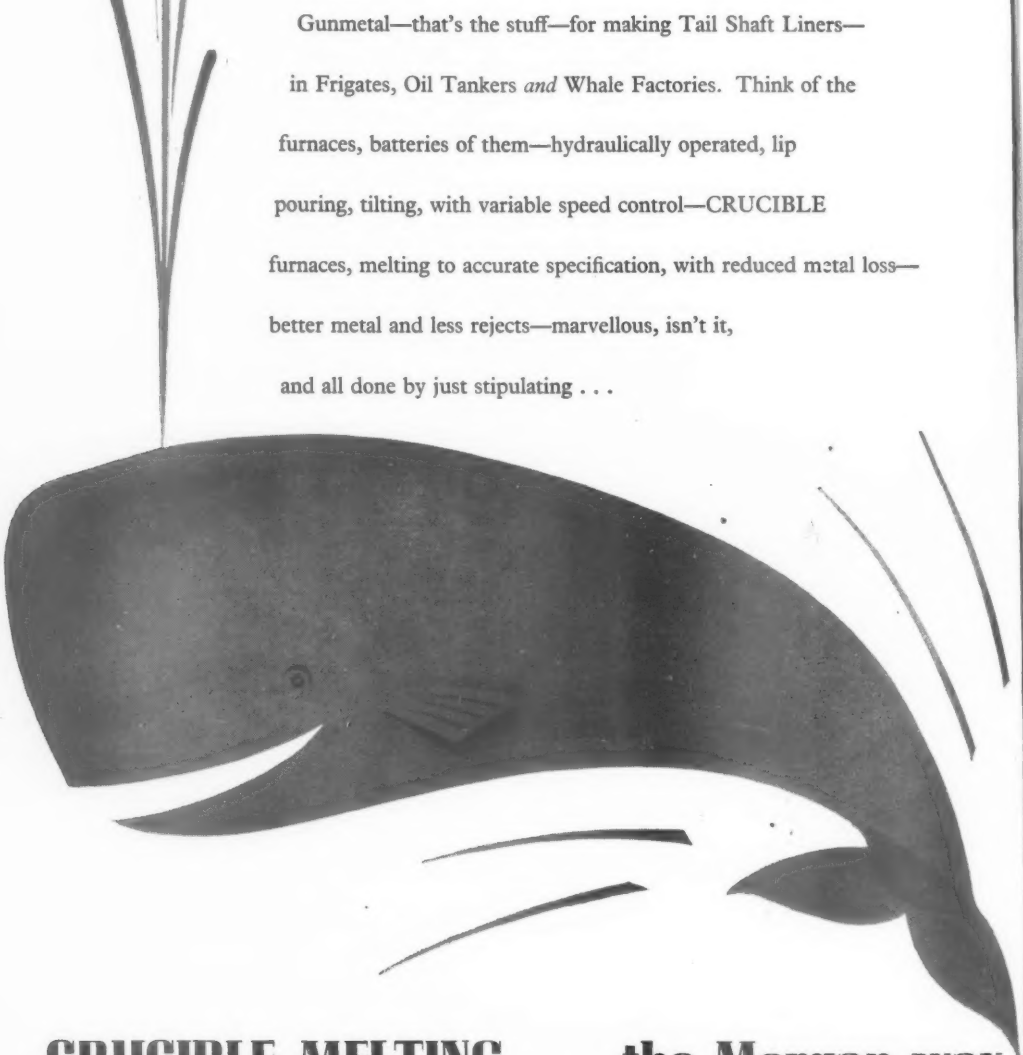

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Established 1902

Vol. 99 Thursday, December 8, 1955 No. 2049

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AN INDUSTRIAL NEWSPAPERS PUBLICATION

Published Weekly

Single copy 9d.; by post 11d.;
Annual subscription: home 40s., abroad 45s. (prepaid)

JOHN ADAM HOUSE,
ADELPHI, LONDON, W.C.2

'Phone: TRAfalgar 6171 (10 lines)
'Grams: Zacatecas, Rand. London.

Five Grey-iron Foundries

One of the most interesting reports emanating from America in recent years is a detailed study of five small iron foundries.* They employ 50, 155, 47, 53 and 24 people and produced 53, 77, 31, 24 and 8 tons, respectively, in a a five-day, 40-hour week. The percentage ratios of good castings to metal melted are reported as 85.22; 88; 71.5; 70.3 and 65.6. However, as these figures relate to the particular week reported on and the foundries are engaged on productions of a varied character, the ratios are not very illuminating, though they are fairly high. The machinery listed as being employed in the first plant (50 men) is quite extensive and includes one squeezer-type and two jolt/rollover moulding machines, a Sandslinger and a Rotoblast cleaning machine.

The largest foundry (155 men), which manufactures cast dies for automobile bodies and corrugated paper, relies on five cranes and an electric hoist. It has no moulding machinery and the sand-preparation plant consists of a sand cutter and a Royer. The third foundry (47 men) has one squeezer-type moulding machine, and a floor-operated 3-ton overhead crane, whilst the fourth (53 men) has ten moulding machines, but only four in use. The last and smallest foundry, an old-established family business, only employs 24 men, but of these 11 are moulders, three are fettlers, one is a coremaker and one a cupola man.

The general pattern of these works is that knocking-out is done by the night-shift men who also operate a sand cutter to prepare backing sand for use next day. All appear to prefer cupolas on the large size, to cut down the time that molten metal is being handled. Wooden moulding boxes are principally used and this involves the employment of a carpenter and sometimes a "boss" carpenter also. The coreshops usually have a paddle mixer and often a home-made drying oven. Some of the cupolas are mechanically charged, but by and large the mechanical aids are no different from those in United Kingdom foundries. Where we detect superiority is in the organization of work by a quite small staff. The outstanding feature of this report is the breakdown of costs, duties, outputs, etc., into a multitude of sections such as one usually associates with only the largest concerns. We doubt if any iron foundry in this country has been so minutely examined—or probably any in America, before this visit of the officials from the Foreign Operations Administration. Any attempt by a British jobbing foundry owner to effect a similar examination would probably result in his getting a proper understanding of his own business for the first time since its creation.

* "Five Small Grey Iron Foundries." A Foreign Operations Administration Report, distributed in Great Britain by the British Institute of Management, 8, Hill Street, London, W.1; price 10s.

Foremen's Training Course

The next foundry foremen's training course, organized by the Institute of British Foundrymen, will be held from April 5 to 7, 1956. On this occasion, the venue will be the Hotel Majestic, Harrogate. The provisional programme includes lectures on "Servicing the Moulder," which will deal with the provision of foundry aids and their maintenance, "Meeting Customers' Requirements," "The CO_2 Process," "Looking after the Apprentice," and "Human Relations." The lectures will be preceded by a display of technical films on the first evening and an address by the president of the Institute, Dr. A. B. Everest, on the following morning.

The Institute has been able to arrange accommodation for 200 at the Hotel Majestic, Harrogate, where there are first-rate meeting facilities, so that the course will be self-contained unless the number exceeds 200, in which case late applicants will have to stay at other hotels. To cover printing, and administrative expenses a registration fee of £1 10s. 0d. for each participant will be payable to the Institute. The hotel charge (payable to the hotel management and *not* to the Institute) for the full period of the course will be £5 5s. 0d. Where two participants are prepared to share a twin-bedded room, the charge will be reduced to £4 15s. 0d. The charge covers all meals, from tea on the afternoon of Thursday, April 5, to luncheon on Saturday, April 7. For those who are not staying the whole period of the course the hotel charge will be 30s. for bed and breakfast. In all cases, bills are subject to an addition of 10 per cent. for gratuities.

Forms of application to attend the course may be obtained from the secretary of the Institute to whom they should be returned not later than February 1, 1956. In past years, the demand for places at these Courses has severely taxed accommodation and this year, with the changed venue, the bookings are sure to be heavy. Those who wish to make certain of places are advised to send notice of their requirements to the Manchester office of the Institute immediately.

London Branch Dinner

At the end of last month, the London branch of the Institute of British Foundrymen held its annual dinner/dance at the Piccadilly Hotel. This represented a change of venue resulting from a desire to accommodate in comfort the increasing numbers of members and guests attending—this year approaching 350. The branch president, Mr. Frank Hudson, F.I.M., occupied the chair, and amongst the guests were Dr. A. B. Everest, national president (who proposed the toast of "The Branch") and Mr. G. Lambert, national secretary. Only short speeches were the rule, to give maximum time for cabaret and dancing. Mr. Hudson replied to the toast proposed by Dr. Everest, and in doing so extended a welcome to the ladies and other guests. He also made a presentation from the branch of a case of silver coffee spoons to Mrs. (and Dr.) Everest, as a memento of their Silver Wedding anniversary which was celebrated recently. The evening's proceedings, compered by Ken Kenyon, included a display of Scottish dancing, the whole organization of the function being ably carried through by Mr. W. R. Buxton, social secretary of the branch.

Latest Foundry Statistics

According to the Ministry of Supply, the output of aluminium castings during September was 1,907 tons from sand moulds, 4,526 tons as gravity-die- and 1,570 tons as pressure-die-castings. The production of magnesium castings was 415 tons.

Congress Paper Author

Mr. Svend Thegel, Author of the Danish Exchange Paper—"Nomogram for Fairly-hot Non-alloyed Iron Cast in ordinary Dry-sand Moulds," printed on the facing page— was born at Skive, Denmark, in 1896. He matriculated in 1913 and later studied at the Royal Technical College, Copenhagen, where he obtained a degree in civil engineering. After completing military service he held various technical appointments. Mr. Thegel joined his present company, Burmeister & Wain, Copenhagen, in 1925, since when he has been attached to the foundries of this firm.

Dinner

BRITISH STEEL FOUNDERS' ASSOCIATION

The dinner of the British Steel Founders' Association was held at Claridge's Hotel on December 2. Mr. F. N. Lloyd, chairman of the Association, proposed the toast of Her Majesty's Government, to which Mr. Peter Thorneycroft, M.P., President of the Board of Trade, responded. The other speakers were Viscount Chandos, Dr. C. J. Dadswell, Mr. G. M. Menzies and Sir Archibald Forbes. Among those present were:—

Sir George Barnett, Mr. H. C. Bradbrook, Mr. Henry Brooke, M.P., Sir Charles Bruce-Gardner, Lord Clydesmuir, Mr. T. A. Crowe, Viscount Davidson, Sir Claude Gibb, Rear-Admiral A. G. V. Hubback, Lieutenant-Colonel Lord Dudley Gordon, Mr. C. H. Kain, Vice-Admiral E. W. L. Longley-Cook, Mr. F. A. Martin, Major R. Miles, Mr. H. P. R. Scott, Mr. W. Scott, and Mr. T. H. Summerson.

Meeting of Investment Founders

A second meeting of representatives of European investment foundries was held in Zürich, Switzerland, recently, at which 25 foundries were represented. Among other discussions, the following papers were read:—"Proper Alloy Selection for Investment Casting," by Mr. H. J. Meerkamp van Embden; "Materials for Cast Rotors and Blades," by Dr. F. Eisermann; "The Investment Casting Industry in USA," by Mr. Ted Operhall; "Survey of the American Investment Casting Industry, made by the Investment Casting Institute," by Mr. W. H. Sulzer; and "The Investment "X"-Process," by Mr. J. S. Turnbull. It was unanimously agreed to continue the co-operation and to hold the next meeting during May, 1956, in Holland.

Forty Years Ago

The December, 1915, issue of the JOURNAL was a vintage one. There was included a very early lecture on "semi-steel" by an eminent metallurgist who happily is still living. A question was asked in Parliament as to why the Admiralty insisted on a 0.02 per cent. phosphorus maximum for shell steel. The following recipe for a flux for brazing cast iron was published:—Zinc chloride, 38; fused borax, 60, and potassium permanganate, 2 per cent. The last was incorporated to oxidize the surface carbon. In this year McKechnie Brothers, Limited, were registered as a limited company.

Nomogram for Fairly-hot Non-alloyed Iron Cast in Ordinary Dry-sand Moulds*

By Sv. Thegel

The object of this work has been to produce a nomogram between thickness of castings, composition and hardness, available for fairly-hot unalloyed and uninoculated cupola iron, cast in ordinary dry-sand moulds. The data are established as a result of testing 50 test-bars each of 20, 30 and 40 mm. dia. All 150 bars were ordinary daily control test-pieces. After close consideration of the different factors influencing the hardness and after the coefficient of correlation of the three different bar diameters was determined for a number of values for composition and hardness, it was decided to fix the nomogram between section size ($C + \frac{1}{3} Si$) and ($H - 30 P$), for which C = carbon, Si = silicon, P = phosphorus and H = Brinell hardness. By means of the equations determined between ($C + \frac{1}{3} Si$) and ($H - 30 P$) for the various diameters, three coherent values for ($C + \frac{1}{3} Si$) and ($H - 30 P$) for each diameter were calculated and the nomogram was constructed. Within the field of utilization of the nomogram mentioned, values for the ($C + \frac{1}{3} Si$), which must be present in the iron in order to get a desired hardness in a given thickness, can easily and quickly be obtained.

Introduction

The purpose of this work—using everyday control results—is to design a thickness/hardness/composition/nomogram available for fairly-hot unalloyed and non-inoculated cupola iron cast in ordinary dry-sand moulds. *Provided sufficient correlation between hardness and composition for the various thicknesses exist that such a nomogram can be designed based on practical results, then, empirically, it follows that this can also be applied practically.*

The question how to get an iron casting with specified qualities is difficult to answer, because it is a foundry problem and the foundry industry is the most difficult of all—the reason being that there is an infinity of factors influencing the properties of the castings. Add to this that demands for mechanical properties are constantly increasing and it will easily be understood that foundry problems are the most complicated of all industries. One of the main problems with cast iron is that mentioned above, *i.e.*, how to get a casting with specified mechanical properties, such as hardness, tensile-, transverse-, compressive-strength, etc.

Some foundrymen have tried to make this task easier by constructing diagrams showing the relation between the structure, *i.e.*, the properties of cast iron, and some of the main factors, which influence the structure. However, it is only the main factors that can be taken into consideration as there are, as seen in the survey, Table I, so many influential factors that it is impossible to consider them all. The hardness is dependent on two main factors, composition and cooling rate, these again being divided into several minor factors.

The question which of the two factors, composition or cooling rate, plays the more important part as regards the hardness of cast iron, cannot be answered, because the two factors are measured in

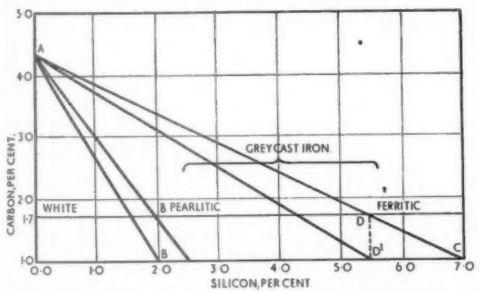

FIG. 1.—*Maurer Diagram* (1924) *relating structure with carbon and silicon for grey cast iron.*

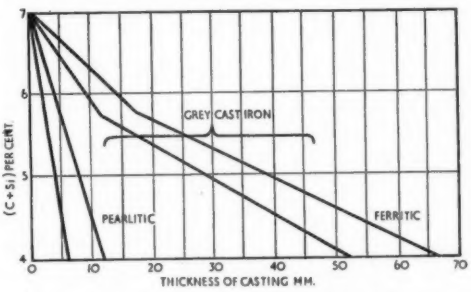

FIG. 2.—*Diagram of Greiner and Klingerstein* (1926) *bringing in structure, section, and* ($C + Si$).

* Official Exchange Paper from the Danish Foundrymen's Association, presented at the fifty-second annual meeting of the Institute of British Foundrymen and International Foundry Congress in London last June. The Author is a civil engineer attached to the Burmeister & Wain Foundry, Copenhagen.

Nomogram for Ordinary Cast Iron

different units, composition in per cent. and cooling rate in degrees per second.

Historical

It would be most interesting to reflect on the historical evolution of the structural diagrams for cast iron; however, this cannot be done here because there are too many. Nevertheless, a few of the best known (Figs. 1 to 5) and most easily used will be mentioned to show the evolution, from the Maurer Diagram[1] in 1924 and up to the present. Maurer's Diagram (Fig. 1), which was based on a theoretical

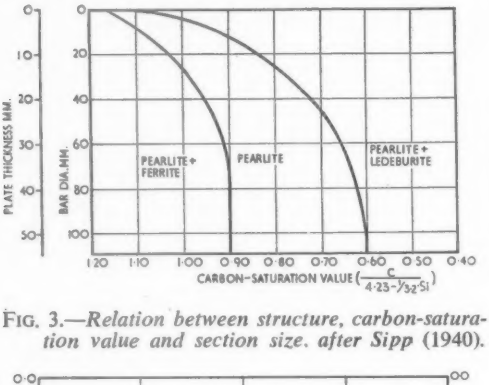

FIG. 3.—*Relation between structure, carbon-saturation value and section size, after Sipp* (1940).

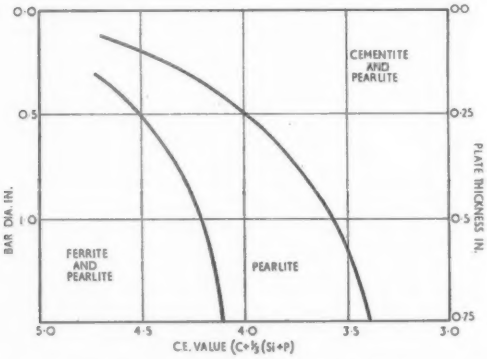

FIG. 4.—*Section size, C.E.-value, and structure relationship, after Angus, Dunn and Marles* (1949).

approach, gives the relation between structure, carbon (C) and silicon (Si) but says nothing about sectional thickness of casting; it is therefore without any practical benefit. Shortly afterwards, however, this fact became evident to Maurer, and in 1927 he, together with Holtzhausen, published a paper in which he stated that his diagram of 1924 was only correct for castings 30 mm. thick.

In 1926, Greiner and Klingenstein[2] made a diagram (Fig. 2) in which they went a step further and took thickness into consideration, making the diagram relate structure, section and C + Si, but they made an error in giving C and Si the same importance. Up to the present, probably the following diagrams are the most used:—

K. Sipp's Diagram[3] (1940), Fig. 3, giving the relation between structure, section size and carbon-saturation value $\left(S_c = \frac{C}{4{,}23 - \frac{Si}{3{,}2}}\right)$ * This diagram can be applied when it is not necessary to consider the phosphorus, *i.e.*, for castings having a low phosphorus content.

In 1947, Laplanche[4] published a diagram relating the silicon, carbon and cooling rate to the microstructure. It is a little complicated and, again, does not consider the phosphorus. In 1949, Angus, Dunn and Marles[5] published a diagram (Fig. 4) involving structure, section size and carbon equivalent (C.E. = C + ¼ (Si + P)). This takes the phosphorus into consideration but only as regards its softening effect and not its greater hardening effect.

In 1950, McElwee and Schneidewind[6] published a picture (Fig. 5) giving the log-log relationship between section size, carbon equivalent (C.E. = C + $\frac{Si}{3} + \frac{P}{4}$) and the main mechanical properties, including hardness. Once again, it considers only the softening effect of P and not its hardening effect; therefore their Brinell hardness scale can only be used for cast iron having low phosphorus content, or when great accuracy is not demanded.

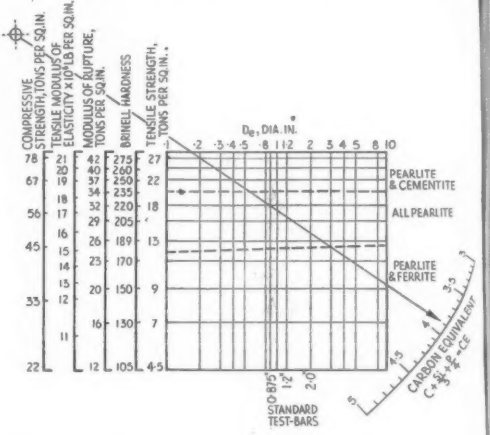
COMPRESSIVE STRENGTH, TONS PER SQ.IN.
TENSILE MODULUS OF ELASTICITY x 10⁶ LB PER SQ.IN.
MODULUS OF RUPTURE, TONS PER SQ.IN.
BRINELL HARDNESS
TENSILE STRENGTH, TONS PER SQ.IN.
D_B, DIA. IN.
PEARLITE & CEMENTITE
ALL PEARLITE
PEARLITE & FERRITE
CARBON EQUIVALENT C+1/3 Si+1/4 P=Ce
STANDARD TEST-BARS

FIG. 5.—*McElwee and Schneidewind diagram bringing together the log-log relationship between section size, carbon-equivalent and main mechanical properties, including hardness.*

* Nowadays: $S_c = \frac{C}{4.3 - 1/3\,(Si + P)}$.

TABLE I.—*Factors Influencing the Hardness of Ordinary Cast Iron.*
(Abbreviations: H for hardness, + increase, − decrease)

I. COMPOSITION.

	Factor.	Effect.
1	+ C	− H, but in very hard iron (i.e., very low Si and with rapid cooling) + C will increase H.
2	+ Si	− H, but only one-third as much as C; from 3.5 per cent. Si, + Si will increase H.
3	+ P	+ H.
4	+ Mn	+ H, when all S is combined as MnS.
5	+ S	+ H, when all Mn is combined as MnS.

II. COOLING RATE.

	Factor.	Effect.
6	+ Cooling rate.	+ H.
7	+ Ratio volume : surface area (i.e., thickness of casting).	− H
8	+ Temperature of mould	− H.
9	+ Heat-conductivity of moulding material (kind of material, dry-sand *v.* green-sand, cement-sand, use of chills, permanent mould, etc.)	+ H.
10	+ Pouring temperature	− H.
11	+ Thickness of mould (if the heat conductivity is greater than that of air)	+ H (and *vice versa*).
12	+ Temperature of shake-out	(Reverse effect to Factor 11)

Value of a Nomogram

The object of making a structural diagram for cast iron in nomogram form is to make available an easily understood method capable of rapid application, which by means of figures indicates the connection between thickness, composition and hardness. This makes it possible easily to obtain figures for the composition (C + ⅓ Si) when the thickness and desired P and hardness are known. Of course, such a nomogram must only be used under the same conditions as those under which it was produced, *i.e.*, fairly-hot unalloyed iron cast in ordinary dry sand. This proviso is fulfilled by a substantial part of the total tonnage of iron castings produced. It follows that the nomogram in question cannot be applied for iron cast in green-sand or in cement-sand moulds, the cooling rate being in both these cases greater than for dry-sand moulded castings. However, nomograms applicable for conditions other than the one mentioned here may be produced in similar manner to that applied here for dry-sand moulded castings.

The three factors put in relation to each other: Hardness, thickness and composition are connected in such a manner that the hardness is dependent on composition and on thickness—or rather on the cooling rate.

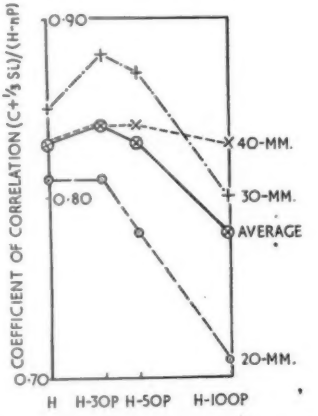

FIG. 6.—*Correlation between (C + ⅓ Si) and hardness according to sectional thickness for various ratios of hardness : phosphorus.*

Hardness

Hardness of cast iron measured by Brinell is in this Paper denoted by H. Primarily, hardness is of considerable economical importance as regards machinability of castings, but also strength, too, is dependent on the hardness, the former increasing with the latter up to about 250 Brinell. Though the hardness initially is dependent on the matrix of the iron and the tensile strength on the quantity of the graphite, numerous recent publications show that a linear relation exists between the hardness and tensile strength of cast iron between 150 and 250 Brinell, when there is no variation in phosphorus or only a slight variation.

Composition

All five normal elements in cast iron C, Si, Mn, P and S have their effects on its structure and consequently likewise on its mechanical properties. Carbon and silicon act strongly in making the iron softer and reducing its strength. However, in iron that is hard by reason of very low Si and rapid cooling or of alloying with carbide-stabilizing elements, *e.g.*, chromium, an increase of carbon will increase the quantity of the very hard carbides, thus making the iron harder. Silicon in excess of about 3.5 per cent. begins to increase the hardness by forming iron silicides, which are themselves very hard. That carbon in regard of softening is three times as effective as silicon is generally acknowledged, therefore

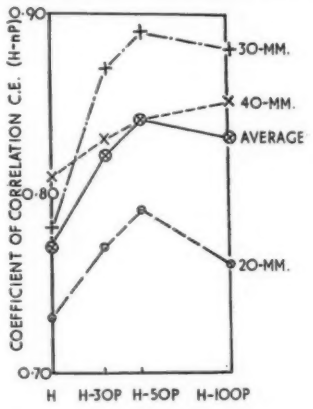

FIG. 7.—*Correlation between carbon-equivalent and hardness according to sectional thickness for various hardness : phosphorus ratios.*

Nomogram for Ordinary Cast Iron

in the following calculations the expression C + ¼Si will be used.

The question whether manganese makes cast iron harder or softer cannot be answered directly, the effect of Mn being dependent of the sulphur in the iron. If there be less Mn in the iron than is necessary to combine with all sulphur (the theoretical amount is 1.7 parts Mn to combine with one part S to form MnS), an increase of Mn will make the iron softer, the hardening effect of S disappearing when it is combined with Mn. On the other hand, when all the sulphur is taken up by the manganese a further Mn increase will make the iron harder. Consequently the question whether Mn makes ordinary cast iron harder or not cannot be answered by a direct negative or affirmative.

Phosphorus increases the hardness of ordinary cast iron by about 30 Brinell points for each one per cent. P (Pearce, J. G.,[7] E. Piwowarsky and Söhnchen[8]). Thus, this recorded increase in hardness must be the resultant of the increase in hardness on account of the steadite and the decrease of hardness due to the graphitizing—and consequently softening—effect of P, the latter is expressed in the formula for the carbon-equivalent value (C.E.) as well as for the carbon-saturation value:

$$S_c = \frac{C}{4.3 - \frac{1}{3}(Si + P)}$$

Sulphur increases the hardness of the cast iron but this effect is normally neutralized by having sufficient Mn to bind all S as MnS; the MnS being harmless in such quantities as are generally to be found.

Section Thickness

The structure of iron and thus its hardness is dependent on the cooling rate in that hardness increases with increasing cooling rate. The cooling rate of iron is dependent on section thickness; use of chills in the casting mould or cores; pouring temperature; the type of moulding sand and the thickness and temperature of the mould. What therefore is to be understood by thickness of casting, and what thickness should be used when applying the nomogram? If the casting is of uniform thickness, this value must be the one which must be used. Should the thickness vary and no demand is made as to strength characteristics, but only that machin-

TABLE II.—*Data for 20-mm. dia. bars Selected*

No.	C.	Si.	P.	C + ¼ Si.	H.	H − 30P.	H − 50P.	H − 100P
1	2.73	2.56	0.78	3.58	269	246	230	191
2	2.93	2.53	0.79	3.77	262	238	222	183
3	2.87	2.41	0.64	3.67	255	236	223	191
4	2.98	2.40	0.61	3.78	255	237	224	194
5	2.94	2.14	0.69	3.65	255	234	220	186
6	2.95	2.41	0.69	3.75	255	234	220	186
7	2.91	1.92	0.76	3.55	255	232	217	179
8	2.88	2.52	0.78	3.72	255	232	216	177
9	2.98	2.37	0.80	3.77	248	224	208	168
10	3.15	2.16	0.57	3.87	244	227	215	187
11	2.81	2.52	0.59	3.65	244	226	214	185
12	2.91	2.45	0.60	3.73	244	226	214	184
13	2.96	2.43	0.59	3.77	244	226	214	185
14	3.01	2.44	0.60	3.82	244	226	214	184
15	3.06	2.37	0.61	3.85	244	226	213	183
16	2.97	2.47	0.70	3.79	244	223	209	174
17	2.96	2.49	0.72	3.79	244	222	208	172
18	2.99	2.54	0.74	3.84	244	222	207	170
19	3.07	2.34	0.72	3.85	244	222	208	172
20	3.13	2.24	0.74	3.88	244	222	207	170
21	3.18	2.33	0.77	3.96	244	221	205	167
22	3.27	2.10	0.85	3.97	244	218	201	159
23	3.11	2.40	0.58	3.91	235	218	206	177
24	3.16	2.58	0.66	4.02	235	215	202	169
25	3.10	2.38	0.72	3.89	235	213	199	163
26	3.01	2.35	0.68	3.79	228	208	194	160
27	3.03	2.43	0.56	3.84	228	211	200	172
28	3.07	2.39	0.56	3.87	228	211	200	172
29	3.11	2.44	0.56	3.92	228	211	200	172
30	3.13	2.05	0.59	3.81	228	210	198	169
31	3.10	2.24	0.61	3.85	228	210	197	167
32	3.08	2.45	0.61	3.90	228	210	197	167
33	3.40	1.74	0.59	3.98	228	210	198	169
34	3.15	2.36	0.66	3.94	228	208	195	162
35	3.27	2.51	0.72	4.11	228	206	192	156
36	3.04	2.69	0.70	3.94	228	207	193	158
37	3.15	2.37	0.45	3.94	223	209	200	178
38	3.24	1.98	0.47	3.90	223	209	199	176
39	3.15	2.51	0.62	3.99	217	198	186	155
40	3.17	2.39	0.58	3.97	217	200	188	159
41	3.16	2.30	0.62	3.93	217	198	186	155
42	3.22	2.45	0.62	4.04	217	198	186	155
43	3.20	2.57	0.63	4.06	217	198	185	154
44	3.27	2.52	0.62	4.11	217	198	186	155
45	3.12	2.54	0.42	3.97	212	199	191	170
46	3.40	2.24	0.48	4.15	207	193	183	159
47	3.14	2.79	0.59	4.07	207	189	177	148
48	3.14	2.36	0.68	3.93	207	187	173	139
49	3.13	2.53	0.72	3.97	202	180	166	130
50	3.46	2.51	0.44	4.30	196	183	174	152
				194.11	11,673	10,707	10,060	8,465
			Average	3.88	233	214	201	169

ability must be good, the minimum section thickness must be applied when using the nomogram. If there be a need for good machinability as well as specification of strength for a casting having varying section thickness then the problem is much more difficult. In this case, there are several ways to proceed. One or several elements, *e.g.*, nickel, which tend to promote structural uniformity in different thicknesses of cast iron, may be used, but in that case diagrams or nomograms applicable for unalloyed cast iron cannot be applied. Chills in casting, mould and cores can be employed. Ingates can be placed in such a manner that the flow of iron passes through the thin parts of the casting thus heating the moulding sand so that the cooling rate there will be reduced. It must be considered whether it is necessary to apply one or several of these methods or leave it.

Next, it is necessary, using the best possible methods, to ascertain what thickness is required in a plate to obtain the same cooling rate which is to be found in the most important part of the casting. It is this thickness which should be applied in using diagrams and nomograms. The ratio of volume: surface-area being essential data for establishing the coiling rate, it may be assumed that a plate will cool just as quickly as a round bar the diameter of which is double the thickness of the plate. This applies for normal dimensions, but, of course, neither for very considerable thicknesses nor for short pieces, in such cases the section thickness to be used must receive more study.

Considering all the factors influencing the hardness of cast iron, it seems a hopeless task to try to make a nomogram suitable to determine the composition of iron having a desired hardness in a given thickness. Fortunately all the factors do not have the same influence, and some of them—C, Si and P—have so great an influence that they overshadow the Mn and S, when these two only are varying normally. It can be assumed that the temperature of moulds almost always is room temperature, and in these cases nomograms made under the same conditions can be used. The effect of varying heat-conductivity of moulding material is so great that it is necessary to allow for this and make different nomograms for the various kinds of moulding material.

It is difficult to say how much influence pouring temperature has on the hardness, but when it is not nearly constant it may be necessary to take such variations into consideration. Temperature of shake-

TABLE III.—*Data for the 30-mm. dia. Bars Selected.*

No.	C.	Si.	P.	C + ¼ Si.	H.	H – 30P.	H – 50P.	H – 100P.
1	3.16	1.20	0.27	3.56	244	236	230	217
2	3.27	1.20	0.33	3.67	235	225	218	202
3	3.25	1.18	0.40	3.64	235	223	215	195
4	3.20	1.18	0.30	3.59	228	219	213	198
5	3.16	1.33	0.30	3.60	228	219	213	198
6	3.28	1.30	0.31	3.71	228	219	212	197
7	3.26	1.27	0.33	3.68	228	218	211	195
8	3.29	1·00	0.38	3.62	228	217	209	190
9	3.22	1.46	0.38	3.71	228	217	209	190
10	3.31	1.29	0.38	3.74	228	217	209	190
11	3.32	1.33	0.38	3.76	228	217	209	190
12	3 25	1.51	0.40	3.75	228	216	208	188
13	3.20	1.34	0.42	3.65	228	215	207	186
14	3.28	1.34	0.47	3.73	228	214	204	181
15	3.29	1.20	0.24	3.69	223	216	211	199
16	3.29	1.22	0.34	3.70	223	213	206	189
17	3.35	1.21	0.38	3.75	223	212	204	185
18	3.26	1.55	0.49	3.78	223	208	198	174
19	3.21	1.47	0.30	3.70	217	208	202	187
20	3.14	1.27	0.31	3.56	217	208	201	186
21	3.25	1.13	0.28	3.63	217	209	203	189
22	3.28	1.43	0.30	3.76	217	208	202	187
23	3.32	1.35	0·31	3.77	217	208	201	186
24	3.20	1.35	0.32	3.65	217	207	201	185
25	3.34	1.07	0.32	3.70	217	207	201	185
26	3.31	1.17	0.35	3.70	217	206	199	182
27	3.29	1.36	0.36	3.74	217	206	199	181
28	3.33	1.35	0.39	3.78	217	205	197	178
29	3.39	1·55	0.55	3.91	217	200	189	162
30	3.18	1.29	0.30	3.61	212	203	197	182
31	3.30	1.15	0.30	3.68	212	203	197	182
32	3.31	1.37	0.31	3.77	212	203	196	181
33	3.25	1.31	0.33	3·69	212	202	195	179
34	3.27	1.32	0.28	3.71	212	204	198	184
35	3.34	1.24	0.27	3.75	207	199	193	180
36	3.32	1.00	0.28	3.65	207	199	193	179
37	3.31	1.34	0.30	3.76	207	198	192	177
38	3.32	1.06	0.26	3.67	202	194	189	176
39	3.40	1.28	0.31	3.83	202	193	186	171
40	3.42	1.41	0·26	3.89	202	194	189	176
41	3.41	1.49	0.29	3.91	202	193	187	173
42	3.38	1·61	0.29	3.92	202	193	187	173
43	3.28	2.16	0.69	4.00	202	181	167	133
44	3.34	1.87	0.78	3.96	202	179	163	124
45	3.26	1.55	0.28	3.78	196	188	182	168
46	3.25	1.77	0.59	3.84	196	178	166	137
47	3.43	2.10	0.91	4.13	196	169	150	105
48	3.70	1.41	0.35	4.17	183	172	165	148
49	3.93	1.50	0.14	4.43	156	152	149	142
50	3.91	1.57	0.22	4.43	156	149	145	134
				188.81	10,679	10,139	9,767	8,876
		Average ..	.. .. ..	3.78	214	203	195	178

Nomogram for Ordinary Cast Iron

out being in most cases room temperature this has been taken into account when constructing this nomogram. If the temperature were essentially higher then there must be made a special nomogram for the particular shake-out temperature.

In this Paper regarding the construction and use of a thickness/hardness/composition nomogram for grey cast iron generally used, it has been taken for granted that Mn and S will vary so little that they make no difference. The effect of C and Si on the hardness is here expressed by C + ¼ Si and the effect of P is to be found in H − 30 P. It is not possible here to consider P by using the C.E. or S_c as one of the parameters, because P acts contrary to C and Si regarding the hardness.

Practical Background

The practical background for this investigation is the results of hardness and analysis testing of 150 round test-bars taken from the daily cupola control tests in a foundry. The test-bars, which were 600 mm. (*c* 2 ft.) in length were run from the bottom in vertical, dry one-piece sand moulds, the moulds having a diameter of 150 mm. (*c* 6 in.) and cast at room temperature. Measurement of hardness and drilling for analysis were made about 50 mm. (2 in.) above the ingate. The castings corresponding to the test-bars, being rather heavy, the pouring temperature of the iron was kept on a sufficient but not too high a level. However, on account of the position indicated for the measurement of hardness and the heating of the mould produced in this place by the flow of the iron it may be taken for granted that the cooling conditions were the same as for castings made of fairly-hot iron.

The 150 test-bars were of diameters 20, 30 and 40 mm. (about ¾, 1⅛ and 1½ in.), 50 of each size. They were selected in chronological order from the tests recorded, some results with uniform figures having been avoided to obtain a sufficient number of varying figures of hardness. The results of C, Si and P determinations, together with the Brinell hardness are shown in Tables II, III and IV for respectively 20-, 30- and 40-mm. diameters. In each table, the tests are arranged in order of decreasing hardness. Table V shows how much the values for composition and hardness vary for the

TABLE IV.—*Data for the 40-mm dia. Bars Selected.*

No.	C.	Si.	P.	C + ¼ Si.	H.	H − 30P.	H − 50P.	H − 100P.
1	3.05	0.71	0.40	3.29	255	243	235	215
2	3.12	0.76	0.35	3.37	248	237	230	213
3	3.04	0.87	0.34	3.33	241	231	224	207
4	2.98	0.65	0.29	3.20	241	232	226	212
5	3.16	0.94	0.41	3.47	235	223	214	194
6	3.09	0.70	0.31	3.32	235	226	219	204
7	3.12	0.93	0.34	3.43	235	225	218	201
8	3.05	0.79	0.38	3.31	235	224	216	197
9	3.19	0.90	0.39	3.49	235	223	215	196
10	3.10	1.00	0.33	3.43	228	218	211	195
11	3.09	1.03	0.36	3.43	228	217	210	192
12	3.13	0.80	0.37	3.40	228	217	209	191
13	3.12	1.02	0.35	3.46	228	217	210	193
14	3.30	0.86	0.40	3.59	228	216	208	188
15	3.21	0.85	0.32	3.49	223	213	207	191
16	3.11	0.94	0.34	3.42	217	207	200	183
17	3.10	0.85	0.32	3.38	217	207	201	185
18	3.25	0.96	0.38	3.57	217	206	198	179
19	3.16	0.94	0.38	3.47	217	206	198	179
20	3.18	0.98	0.36	3.51	217	206	199	181
21	3.28	1.04	0.39	3.63	217	205	197	178
22	3.17	1.21	0.42	3.57	217	204	196	175
23	3.26	0.85	0.31	3.54	212	203	196	181
24	3.14	1.09	0.31	3.50	212	203	196	181
25	3.18	1.03	0.37	3.52	212	201	193	175
26	3.29	1.10	0.35	3.66	212	201	194	177
27	3.28	1.08	0.28	3.64	207	199	193	179
28	3·19	1·19	0·27	3·59	207	199	193	180
29	3.06	1.16	0.29	3.45	207	198	192	178
30	3.35	0.91	0.37	3.65	207	196	188	170
31	3.13	1.06	0.39	3.48	207	195	187	168
32	3.12	1.10	0.40	3.49	207	195	187	167
33	3.26	0.96	0.28	3.58	202	194	188	174
34	3.37	1.04	0.30	3.72	202	193	187	172
35	3.13	1.00	0.34	3.46	202	192	185	168
36	3.31	1.07	0.33	3.67	202	192	185	169
37	3.30	0.98	0.38	3.63	202	191	183	164
38	3.26	0.83	0.40	3.54	202	190	182	162
39	3.21	1.32	0.42	3.65	202	189	181	160
40	3.49	0.80	0.44	3.76	202	189	180	158
41	3.51	0.97	0.24	3.83	196	189	184	172
42	3.27	1.11	0.31	3.64	196	187	180	165
43	3.37	1.23	0.30	3.78	196	187	181	166
44	3.29	1.10	0.32	3.66	196	186	180	164
45	3.26	1.12	0.37	3.63	196	185	177	159
46	3.36	0.96	0.35	3.68	196	185	178	161
47	3.39	0.96	0.35	3.71	196	185	178	161
48	3.30	1.32	0.39	3.74	196	184	176	157
49	3.41	0.90	0.45	3.71	196	182	173	151
50	3.56	0.80	0.53	3.83	192	176	165	139
				177.30	10,704	10,169	9,803	8,927
			Average ..	3.55	214	203	196	179

tests with diameters, respectively, of 20, 30 and 40 mm. To make the Paper complete, variations for Mn and S have been included.

Test Methods.—The figures of Tables II, III and IV have been ascertained as follow:—

C was determined volumetrically after combustion to CO_2 in oxygen in an electric furnace.

Si was determined as SiO_2. The sample was dissolved in a mixture of acids, evaporated, baked, dissolved in dilute HCl, the SiO_2 filtered, ignited and weighed.

P was precipitated as the yellow phosphomolybdate complex, from which the phosphorus was determined by titration with $NaOH/H_2SO_4$. (Nowadays, P is determined photometrically.)

The hardness tests were carried out on a Brinell machine with a 10-mm. ball and a pressure of 3,000 kg. held for about 10 sec. (10/3,000/10).

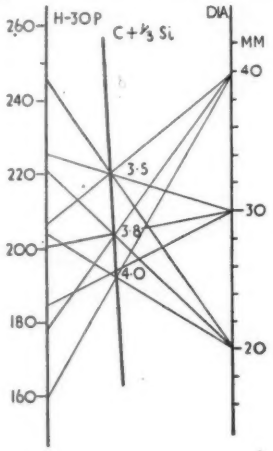

FIG. 8.—*Construction of the nomogram connecting section/carbon + ⅓ silicon/phosphorus/hardness of non-alloyed iron, cast in dry sand.*

Choice of Parameters

The question was posed of how best to express the composition (C, Si and P) and the hardness (H). When it is established that P increases the hardness of cast iron, it will be suitable to use the expression H − *n*P, in which *n* is a round figure, as one of the parameters. Having taken into consideration the effect of P, (C + ⅓ Si) was used as the other parameter. In this manner the use of the nomogram will be easier than if C.E. or S. is used. Furthermore, the (C + ⅓Si) gives the advantage compared with C.E. that it is unique, while C.E. at present has various meanings, some people using C.E. = C + ⅓(Si + P), which has also been used in this work, while others use C.E.= C + 0.3(Si + P).

Having determined to use (C + ⅓Si) and (H − *n*P) the next question is what figure to choose for *n*; P, as mentioned in the introduction, having been found to increase the hardness of cast iron

TABLE V.—*Limits of Values for the Test-bar Selected.*

Diam.	20 mm.	30 mm.	40 mm.
C	2.73 to 3.46	3.14 to 3.93	2.98 to 3.56
Si	1.74 to 2.79	1.00 to 2.16	0.65 to 1.32
P	0.42 to 0.85	0.14 to 0.91	0.24 to 0.53
C + 1/3 Si ..	3.55 to 4.30	3.56 to 4.43	3.20 to 3.83
H	196 to 269	156 to 244	192 to 255
Mn	0.33 to 0.94	0.38 to 1.00	0.52 to 0.92
S	0.065 to 0.140	0.075 to 0.140	0.080 to 0.145

about 30 Brinell points for each one per cent., it is tempting to choose $n=30$ just as Jean Guillamon[8] has done. Before *n* is finely fixed it would, however, be interesting to calculate the coefficient of correlation (*r*) for (C + ⅓Si) / (H − *n*P) for *n* = 0, 30, 50 and 100. The calculation necessary has not been included *in extenso* in this Paper to save space, and only one example of such a calculation is given (see Table IX). The results, however, are shown in Table VI. That the correlation will be

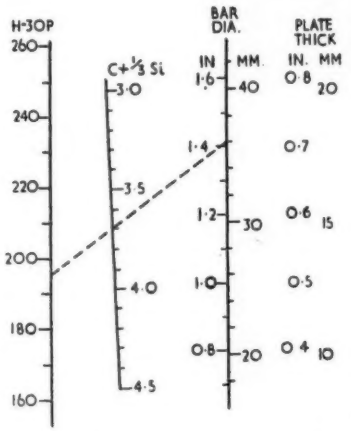

FIG. 9.—*Nomogram extended to embrace equivalent plate thicknesses and indicating the method of application and a selected example.*

TABLE VI.—*Coefficient of Correlation (C + ⅓ Si) / (H − nP) for the Material Used.*

Dia.	H.	H − 30P	H − 50P	H − 100P
mm.				
20	−0.81	−0.81	−0.78	−0.71
30	−0.85	−0.88	−0.87	−0.80
40	−0.83	−0.84	−0.84	−0.83
Average ..	−0.83	−0.84	−0.83	−0.78

best between (C + ⅓Si) and (H − 30P) checks very well with the fact that 1 per cent. P will increase Brinell with 30.

In comparison, the coefficient of correlation C.E. / (H − *n*P) is likewise calculated, the results being shown in Table VII. Here, the correlation is best between C.E. and (H − 50P), while as to (C + ⅓Si) the best correlation was by using (H − 30P).

Examining the graphs of these results (Figs. 6

Nomogram for Ordinary Cast Iron

TABLE VII.—*Coefficient of Correlation C.E.*/(*H* − *nP*).

Dia.	H.	H − 30P	H − 50P	H − 100P
mm.				
20	−0.73	−0.77	−0.79	−0.76
30	−0.78	−0.87	−0.89	−0.88
40	−0.81	−0.83	−0.84	−0.85
Average ..	−0.77	−0.82	−0.84	−0.83

and 7) it will be seen that the coefficient of correlation for (C + ⅓Si) has its maximum very close to (H − 30P), whereas for C.E. it has its maximum between (H − 50P) and (H − 100P) but most closely, however, in the first case. The positions found for the maxima of the coefficient of correlation correspond with the fact that P is found in C.E. = (C + ¼ (Si + P)) but not in (C + ⅓Si).

Construction of the Nomogram

Having determined that the cast iron nomogram was to be applied for thickness/(H − 30P)/(C + ⅓Si) the equations between (H − 30P) and (C + ⅓Si) for 20, 30, and 40 mm. dia. were calculated in the manner shown in Table IX. The following values were found.

Equations:

For 20-mm. dia.
$$(H - 30P) = -85\,(C + \tfrac{1}{3}Si) + 544$$

For 30-mm. dia.
$$(H - 30P) = -82\,(C + \tfrac{1}{3}Si) + 513$$

For 40-mm. dia.
$$(H - 30P) = -93\,(C + \tfrac{1}{3}Si) + 533$$

To determine the position of the line (C + ⅓Si) of the nomogram and its units, three points of the line are required. To obtain this, three values of (C + ⅓Si), 3.5, 3.8 and 4.0, were applied in the above equations and the values for (H − 30P) calculated. The results are shown in Table VIII. By means of these figures relating between diameter, (C + ⅓Si) and (H − 30P), it is now easy to draw the nomogram (Fig. 8).

On two vertical lines, values for (H − 30 P) and

TABLE IX.—*Example of Calculation of Correlation.*
(H − 30P/C + ⅓ Si for 20-mm. dia. bars).

No.	H − 30P.	Δ (H − 30P)*.	Δ² (H − 30P).	C + ⅓ Si.	Δ (C + ⅓ Si).10³.	Δ² (C + ⅓ Si).10⁴.	Δ (H − 30P). Δ (C + ⅓ Si).
1	246	+32	1,024	3.58	−30	900	− 9.6
2	238	+24	576	3.77	−11	121	− 2.6
3	236	+22	484	3.67	−21	441	− 4.6
4	237	+23	529	3.78	−10	100	− 2.3
5	234	+20	400	3.65	−23	529	− 4.6
6	234	+20	400	3.75	−13	169	− 2.6
7	232	+18	324	3.55	−33	1,089	− 5.9
8	232	+18	324	3.72	−16	256	− 2.9
9	224	+10	100	3.77	−11	121	− 1.1
10	227	+13	169	3.87	− 1	1	− 0.1
11	226	+12	144	3.65	−23	529	− 2.8
12	226	+12	144	3.73	−15	225	− 1.8
13	226	+12	144	3.77	−11	121	− 1.3
14	226	+12	144	3.82	− 6	36	− 0.7
15	226	+12	144	3.85	− 3	9	− 0.4
16	223	+ 9	81	3.79	− 9	81	− 0.8
17	222	+ 8	64	3.79	− 9	81	− 0.7
18	222	+ 8	64	3.84	− 4	16	− 0.3
19	222	+ 8	64	3.85	− 3	9	− 0.2
20	222	+ 8	64	3.88	0	0	0.0
21	221	+ 7	49	3.96	+ 8	64	+ 0.6
22	218	+ 4	16	3.97	+ 9	81	+ 0.4
23	218	+ 4	16	3.91	+ 3	9	+ 0.1
24	215	+ 1	1	4.02	+14	196	+ 0.1
25	213	− 1	1	3.89	+ 1	1	0.0
26	208	− 6	36	3.79	− 9	81	+ 0.5
27	211	− 3	9	3.84	− 4	16	+ 0.1
28	211	− 3	9	3.87	− 1	1	0.0
29	211	− 3	9	3.92	+ 4	16	− 0.1
30	210	− 4	16	3.81	− 7	49	+ 0.3
31	210	− 4	16	3.85	− 3	9	+ 0.1
32	210	− 4	16	3.90	+ 2	4	− 0.1
33	210	− 4	16	3.98	+10	100	− 0.4
34	208	− 6	36	3.94	+ 6	36	− 0.4
35	206	− 8	64	4.11	+23	529	− 1.8
36	207	− 7	49	3.94	+ 6	36	− 0.4
37	209	− 5	25	3.94	+ 6	36	− 0.3
38	209	− 5	25	3.90	+ 2	4	− 0.1
39	198	−16	256	3.99	+11	121	− 1.8
40	200	−14	196	3.97	+ 9	81	− 1.3
41	198	−16	256	3.93	+ 5	25	− 0.8
42	198	−16	256	4.04	+16	256	− 2.6
43	198	−16	256	4.06	+18	324	− 2.9
44	198	−16	256	4.11	+23	529	− 3.7
45	199	−15	225	3.97	+ 9	81	− 1.4
46	193	−21	441	4.15	+27	729	− 5.7
47	189	−25	625	4.07	+19	361	− 4.8
48	187	−27	729	3.93	+ 5	25	− 1.4
49	180	−34	1,156	3.97	+ 9	81	− 3.1
50	183	−31	961	4.30	+42	1,764	−13.0
	10,707		11,409	194.11		10,479	−89.2
Average ..	214			3.88			

* Δ (H − 30P) = (H − 30P) − $\overline{(H - 30P)}$ *i.e.*, (H − 30P) − the average of (H − 30P)

TABLE IX. *continued.*

Coefficient of correlation r $= \dfrac{\Sigma\Delta\,(H-30P).\,\Delta(C+\frac{1}{3}Si)}{\sqrt{\Sigma\Delta^2\,(H-30P).\,\Sigma\Delta^2\,(C+\frac{1}{3}Si)}}$

$$r = \frac{-89.2}{\sqrt{11{,}409 \times 1.0479}} = -0.81$$

Equation of correlation:

$$(H-30P) - \overline{(H-30P)} = \frac{\Sigma\Delta\,(H-30P).\Delta(C+\frac{1}{3}Si)}{\Sigma\Delta^2\,(C+\frac{1}{3}Si)} \cdot (C+\tfrac{1}{3}Si) - \overline{(C+\tfrac{1}{3}Si)}$$

$$(H-30P) - 214 = \frac{-89.2}{1.0479}\,((C+\tfrac{1}{3}Si) - 3.88)$$

$$(H-30P) = -85\,(C+\tfrac{1}{3}Si) + 544.$$

diameter are given respectively. The units chosen are equidistant on both lines. From each of the points 20, 30 and 40 on the diameter scale, three straight lines are drawn to the corresponding points (see Table VIII) on the (H – 30 P) scale. The three lines corresponding to the (C + ⅓ Si) value 3.5 will cut each other in one point and this point will get the value 3.5 on the (C + ⅓ Si) scale. In the same way, a point will be found for (C + ⅓ Si) = respectively 3.8 and 4.0. The basis of this work being empirical the points found are of course not mathematical points. Two of the points found are sufficient to be able to draw the line (C + ⅓ Si) desired. The third point, which the line must of course intersect, serves to show that the measurements for (C + ⅓ Si) are equidistant, showing that the distance between the points 3.8 and 4.0 are two-thirds of the distance between 3.5 and 3.8.

TABLE VIII.—*Coherent values of Diameter (C + ⅓ Si) and (H – 30P).*

Dia.	C + 1/3 Si.	H – 30P.
mm.		
20	3.5	246
20	3.8	221
20	4.0	204
30	3.5	226
30	3.8	201
30	4.0	185
40	3.5	207
40	3.8	179
40	4.0	161

An example of calculation of coefficient of correlation and the equation of correlation is given in Table IX. Of course, the calculation necessary for construction of the nomogram can be made graphically instead of mathematically as shown in the graph (Fig. 10), which presents the same example as shown mathematically in Table IX. The mathematical method has been used in this Paper in order to obtain figures for the coefficient of correlation and in this way find out which parameters give the best correlation. In all probability, the parameters (C + ⅓ Si) and (H – 30 P) will also be most advantageous when all similar nomograms are constructed. The parameters having been fixed beforehand, only two or three calculations, graphical or mathematical, are necessary instead of the 24 calculations made in this paper to obtain the different coefficients of correlation shown in Table VI and VII.

Application

This nomogram is produced for the purpose of being an aid to the practical foundryman. Within the sphere in which the nomogram can be used, it is possible—easily and quickly— to obtain the (C + ⅓ Si) value that is required in the iron to attain a desired hardness in the casting. The first thing is to decide how much P is to be included, provided this has not already been decided by the customer himself. For calculation, phosphorus has the advantage over other elements in the iron in that there is practically no change in this element when melting in the cupola. This means that it is only necessary to have the P per cent. in the charge the same as that desired in the casting. Having fixed the desired P per cent., 30 P is subtracted from the desired Brinell.

From the figure thus obtained in the (H – 30 P) scale (Fig. 9), a straight line is drawn to the point in the section-thickness scale which is the ruling thickness to be catered for (see "section-thickness" in the introductory section). The point of intersection of this line with the line (C + ⅓ Si) gives the (C + ⅓ Si) value required in the casting. Thereupon the foundryman must, according to his knowledge of his cupola, calculate what mixture is to be charged.

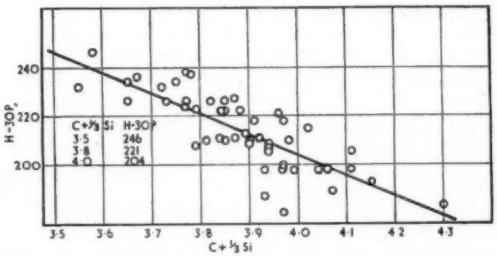

FIG. 10.—*Graphical presentation of the data used for formulating the nomogram.*

Example

A casting is to be produced which with a wall thickness of 18 mm. (¾ in.) has a hardness between 190 and 220 Brinell (average 205); about 0.3 per cent. P is required in this casting. In the nomogram, a straight line (dotted in Fig. 9) is drawn from the 18-mm. plate to H – 30 P = 205 – 9 = 196. The intersection of this line with the (C + ⅓ Si) line gives a value of about 3.7 for the (C + ⅓ Si) required. In calculating his mixture, the foundryman must see that C + ⅓ Si in the casting is kept between 3.6 and 3.8 per cent.

As seen in the nomogram, increase of carbon and of silicon will decrease and increase of phosphorus will increase the hardness. This corresponds perfectly with the survey in Table I, thus it is clear that results obtained by using this kind of nomogram will agree with practice.

Acknowledgment

The Author wishes to thank A/S Burmeister & Wain's Maskin-og Skibsbyggeri, Copenhagen, K., for permission to present this Paper at the International Foundry Congress, in London, 1955.

Nomogram for Ordinary Cast Iron

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DISCUSSION

MR. E. M. CURRIE said he had looked at the matter from the standpoint of a man who had to produce castings for customers and he had the feeling that Mr. Thegel's Paper was, from this viewpoint, little more than an interesting statistical exercise. In producing the nomogram the Author was following on similar nomograms produced by Maurer and others. The reason why he made the criticism (and he did not mean it unkindly, because undoubtedly papers such as this made foundrymen think about the physical properties they were going to get), was because Mr. Thegel said it was produced for the purpose of being an aid to *practical* foundrymen, and it was at that point that he begged to differ. The application of the carbon, silicon, and phosphorus quantities related merely to hardness figures, determined on test-bars of various sizes, 20 to 400 mm. dia., was insufficient data. From the practical foundryman's point of view, that had no bearing whatsoever on the physical properties of a casting where strengths, in the way of tensile, compressive or perhaps fatigue, had to be maintained in a casting.

He knew Mr. Thegel's foundry, and in their case, working on diesel-engine production, the question of physical strengths in various sections was very important indeed, but hardness played only a small part. He noticed also with mild regret that Mr. Thegel had said that phosphorus content, if it were to be included, might be specified by the customer. That, he thought, was an undesirable suggestion from the ironfounder's point of view.

MR. THEGEL agreed that tensile strength was of importance in many cases, but thought he was correct in saying that there were also many cases where hardness was essential. He had talked about ordinary iron for ordinary use, not for specialized use. As to phosphorus, let the customer tell founders what phosphorus content he desired. Founders might not like it, but sometimes a customer would state his requirements and then founders had to meet them.

MR. CURRIE asked why Mr. Thegel laid such stress on hardness. Was it to placate the machinist, or from interest in relation to the strength of the casting?

MR. THEGEL replied it was from the machining standpoint.

Importance of Hardness

MR. T. KROGVIG (Norway) said hardness was often specified. Moreover, iron had to meet a certain class of strength. He found it might often be important to be able to control both properties and there he thought the nomogram would be quite useful. As the Author had said, for ordinary iron and for a certain moulding method, a founder could build up his own diagram with that nomogram as a guide. Also, of course, it had to be a foundry which already had good control and took analyses of each melt and many other tests. At present, he thought the nomogram would be of use for larger foundries where the hardness was specified, and for two reasons: there might be a minimum hardness specified to secure good wear-resistance, or a special requirement of better machinability. That was quite important; alternatively, it often happened that a maximum phosphorus was specified, though perhaps not so much in England as on the Continent—especially with machine-tool castings.

MR. THEGEL thanked Mr. Krogvig for his kind remarks.

THE CHAIRMAN, MR. H. J. V. WILLIAMS, closing the session, thanked Mr. Thegel for his contribution and mentioned that it represented the Exchange Paper from the Danish Foundrymen's Association. He thanked him most sincerely for preparing it and for the able manner in which he had been able to put it over.

US Steel Plant for India

New steel plant in India is to be built by the Henry J. Kaiser Company, of the United States, following an agreement which it has signed with the Tata Iron & Steel Company, Limited. The plant will be built at Jamshedpur, about 150 miles west of Calcutta, at a cost of $130,000,000 (about £46,428,570); the work is scheduled for completion in two and a half years.

The Indian Government has contracted for two other steel mills, one to be built by the German Krupp Demag concern and the other by the Soviet Union. According to Moscow Radio the blueprints for the latter plant have been completed by Russian technicians. They include a training scheme for Indian operatives. Indian steel capacity is likely to be further increased by the project now being prepared by the British consortium for a 1,000,000-ton, State-owned steel plant in Durgapur, west Bengal.

Basic Materials Cost Less

There was a further fall in October in the overall level of prices of basic raw materials used in British industry from the three-year record level reached in August.

The Board of Trade's monthly index (based on June 30, 1949) fell by 1.9 per cent. to 153.0 between September and October, to which the lower prices for raw rubber (down 14.7 per cent.) and copper (down 4.8 per cent.) contributed substantially.

Prices of materials used in the mechanical engineering and electrical machinery industries, which had risen substantially over the previous four months, fell in October by 1.3 and 2.2 per cent. respectively. These decreases were mainly due to lower average prices for various brass and copper items. The price index for iron and steel products rose by 0.2 per cent., due to higher prices for tinplate and high-speed tool steel finished bars.

Output of Iron Castings

Third Quarter's Figures

In the third quarter of 1955, production of iron castings was 3.5 per cent. higher than in the corresponding quarter of 1954. In the first half of 1955, it had been 6.5 per cent. above the corresponding 1954 level. The drop in output compared with the second quarter of 1955 was of normal seasonal amount, due to holidays.

Main Sectional Divisions

In the third quarter of 1955, the production of automobile castings was nearly 15 per cent. more than in the corresponding quarter of 1954. The production of ingot moulds was nearly 10 per cent. above the corresponding 1954 level; these are mostly used in the manufacture of steel. Engineering castings output was nearly 6 per cent. up on 1954, but pipes and building and domestic castings were fractionally down, and railway castings tonnages continued appreciably below the 1954 level.

Table I shows the output of iron castings in the third quarter of 1955 for each of the six main sections of the ironfounding industry, compared with the corresponding quarter of 1954.

TABLE I.—*Iron Castings Output for the Third Quarter, 1955, by Sections.*

Section.	Tons.		Percentage change.
	1954. Third quarter.	1955. Third quarter.	
Automobile (including tractors) ..	109,970	126,140	+14.7
Ingot moulds	78,870	86,640	+ 9.9
Engineering and jobbing	308,560	326,840	+ 5.9
Building and domestic	129,040	127,080	− 1.5
Pressure pipes and malleable-tube fittings	158,590	153,380	− 3.3
Railway equipment	69,090	63,540	− 8.0
Total	854,120	883,620	+ 3.5

District Production

The improvement over a year ago is widely spread. In the third quarter, most ironfounding districts had a higher output than a year previously and none of the declines was serious. Of the larger areas the West Midlands again showed the greatest increase. For the first time on record it produced more than one-fifth of the UK tonnage of iron castings.

Raw Materials

The ironfounding industry's consumption of its principal raw materials, pig-iron and scrap, is shown in Table II.

TABLE II.—*Pig-iron and Scrap Consumption by Foundries.*

	Tons.		Percentage increase.
	1954. Third quarter.	1955. Third quarter.	
Pig-iron (including refined iron) ..	529,560	546,490	+ 3.2
Iron and steel scrap (about half is foundry circulating scrap) ..	677,010	699,720	+ 3.4

The shortage of hematite pig-iron has been considerably eased by higher production, and foundry stocks were re-built during the third quarter. There is a plentiful supply of high-phosphorus iron and foundries

(*Continued at foot of Col.* 2)

Notes from the Branches

South Africa

At the October meeting of the South African branch of the Institute of British Foundrymen, Mr. A. L. Bradley presented a Paper entitled "Production of Magnesia for Refractories from Sea Water." Methods used for this process in the United Kingdom are outlined and illustrations of operating plant were also shown. After a brief discussion on the subject matter of the Paper, Dr. Cooper, metallurgist of the Rhodesian Railways, asked for some first-hand information about basic-lined cupolas in the Johannesburg area. Several operators of this type of cupola replied, and in particular, it was stressed that in South Africa this lining method was particularly favoured because of the inferior type of coke (high in sulphur) which was available. One operator quoted a recent sulphur content for his iron, of 0.021 per cent. The discussion was concluded by a vote of thanks proposed by Mr. Godfrey.

Works Visit

Also in October members and guests visited the steel division of Hume Pipe Company (S.A.), Limited. The firm was established in 1919 for the manufacture of concrete pipes and in 1931 commenced the production of steel pipes. This factory was erected and production started in 1948 under the supervision of the present works manager, Mr. G. L. M. Judd. The works cover an area of 32 acres and provide employment for over 1,000 employees. The equipment installed caters for production of pipes up to 72-in. dia. by 32-ft. long, with $\frac{1}{4}$-in. wall thickness, the largest weighing 8 tons. All pipe seams are welded by the submerged-arc process and flange manufacture is facilitated by a flash butt-welder capable of joining a 5- by 2-in. section in 30 sec. The entire pipe output is tested by four hydraulic installations. A 220,000-v. X-ray plant and a ×6 to ×6,000 magnification microscope enables weld and material checks to be performed. The factory has a handling capacity for 4,000 tons of steel per month, and products are supplied for gas and water installations, to mines and uranium plants throughout the Union and Central Africa.

One interesting contract completed by this firm was the design, manufacture and installation of the recently-opened Orange Free State trunk main. 28,000 tons of steel were used for this 45-mile line of 46-in. dia. pipe, and the contract was completed in twelve months. A unique feature of this contract was the use, on site, of a portable unit to weld the pipe sections *in situ*. The unit, designed by Mr. Judd and his staff, is reputed to be the first of its type ever placed in operation on a job of this nature.

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are well stocked. However, the supply position of low-phosphorus foundry iron continues to cause concern; this quality is mainly required by makers of castings for the automobile and engineering industries.

Labour

The number of persons employed in the ironfounding industry at October 1955, was 144,727, which is 878 more than at the beginning of the quarter, thus reversing the fall in the preceding quarter. Both these movements were mainly seasonal. The increase compared with a year ago was 4,553 persons.

F. H. Lloyd's Prizegiving

Mr. M. C. Lloyd, speaking at the annual apprentice prizegiving of F. H. Lloyd & Company, Limited, said the object of the training department was to provide a steady flow of skilled craftsmen of all trades, capable of carrying on the high traditions of skill and craftsmanship handed down to them by the older generations. F. H. Lloyd were justly proud of the skill and loyalty of their workpeople. In turn the company hoped that as their training progressed, the apprentices would take a pride in the company for which they worked.

Mr. Lloyd added that the foundry training section was nearing completion and plans were in an advanced state for the extension of training department headquarters to include facilities for an apprentice club and the development of a large modern engineering training section in the grounds at the back of the house. He paid tribute to the value of the American scholarship and to the work of the training officer and his staff. Mr. D. B. Beynon gave a report on events of the past year and emphasized the man-training side of the training programme.

Then came the distribution of prizes and cash awards for technical college and works progress. This was followed by special awards and certificates for physical recreation. The "Rose Bowl" was won by the engineering apprentices, the "Sportsman of the Year" trophy being awarded to Bryan P. F. Whitehouse, a patternmaker apprentice. Mr. C. Thompson, chairman of the apprentice club, proposed a vote of thanks, saying that the apprentices were proud to belong to such a company.

The premiere of the new F. H. Lloyd film "Moulding Men," produced by the training department of the company, was next on the agenda. It showed some of the outstanding events in apprentice training during 1955.

Long-service Compressor

Holman Bros., at their Camborne, Cornwall, works, recently answered an unusual request for service information, concerning a Holman compressor which research by the company revealed was first supplied at about the turn of the century. It was still in use at a mine, Utica Lease, in British Columbia. The enquirer wrote: "There is no serial number or model nameplate on the machine, though the words Holman, Camborne, England, are cast on the side bedplates. The machine must be 38 to 40 years old and is giving excellent service. We are driving it with a Pelton water wheel at present, but we must change over to a diesel unit and must know as soon as possible what the highest safe speed would be for this compressor. We realize that the drawings may long ago have been relegated to the archives, but we are so pleased that we want to continue using it with another drive. . . ."

The company believes that this type of machine was first supplied to the famous South Crofty tin mine in Cornwall. Not surprisingly, the drawings had been relegated to the archives, but the machine was identified as a 16- by 18-in. horizontal type, with a displacement of 502 cub. ft. per min. and an 8-ft. dia. flywheel turning at 120 r.p.m. The company advised against an increase in speed for this machine.

BELARK TOOL & STAMPING COMPANY, LIMITED, have changed their address to 9, Carnaby Street, London, W.1.

Definition of Monopolies

In a letter to the President of the Board of Trade on the proposed restrictive practices legislation, the National Union of Manufacturers states that it is emphatically opposed to any restrictive practice which is shown to be against the public interest. It accepts the proposed registration procedure, and so far from trying to cripple the proposed tribunal, regards it as essential that the tribunal should be effective and of the greatest authority.

In the NUM's view the main issue is whether a statutory definition of the public interest in this matter should be attempted for the guidance of the tribunal, and it expresses the belief that such a definition is not practicable, as any general definition may well be either too narrow to be just or too wide to be effective. It suggests that the question where the onus of proof should lie depends on the determination of this main issue. If a statutory definition is practicable, the onus must lie on those practising the defined restriction.

But, believing that an *a priori* definition is not practicable, the NUM advocates a judicial procedure in which the fact that a particular practice has effects contrary to the public interest should be proved by the ordinary rules of evidence. If this is *prima facie* established, the onus then shifts to the parties to the practice to prove any beneficial effect which they claim for it. The manufacturers believe that this factual approach, whereby a judicial tribunal will assess the balance of effect, adverse or beneficial, of a particular practice, is likely to be more effective, more expeditious, and more just than an assessment by *a priori* definition; and that a single judicial decision adverse to a particular practice will in itself lead to a discontinuance or modification of analogous practices.

British Standard Revised

Manhole Step-irons (*BS* 1247: 1955)

British Standard No. 1247 for manhole step-irons, first published in 1945, has been reviewed in the light of present-day practice. It was found that the designs were still satisfactory but that there was a demand for a plain-bar corner-type step-iron and details of this type have been added to the standard. No material change has been made in the test requirements except that, since it was considered more realistic to relate the amount of bending in the malleability test to the respective lengths of the step-irons, a diagram has been included giving the distance between the tail portions to which the step-irons should be closed in order to pass the malleability test. These distances are in direct relation to the overall length of the step-iron being tested. No change has been made to the requirement that a proof-load test should be made only by arrangement between purchaser and supplier, since this has been found to work satisfactorily.

The standard now specifies a round-bar type of corner step-iron for fixing in brickwork, in addition to the types for normal use and for reinforced-concrete manholes to BS 556. The round-bar type corner step-iron is of the same type as that which has been shown in BS 1130 for some time, but was not fully dealt with in that standard; its inclusion in this standard enables it to be related to the tests for proof load and malleability applicable to the projecting types of step-iron. An Appendix gives the approved method of applying the proof-load test if required. Copies of the standard are obtainable from the Sales Branch of the British Standards Institution, 2, Park Street, London, W.1; price 2s. 6d. each net.

The Foundry Industry in Australia*

Discussion of the Australian Exchange Paper by A. W. Silvester

The completeness of the Author's survey of Australian foundry manufacturing conditions made it difficult for questioners, and comment was mainly of a congratulatory nature. Topics included stressing of problems imposed on the Australian industry by the remoteness of manufacturing centres from one another; the popularity of "block-core" moulding and the competitive position of Australian founders.

When the Exchange Paper from the Australian (Victoria) branch of the Institute of British Foundrymen—entitled "The Foundry Industry in Australia"—was presented at the International Foundry Congress held in London, THE JOINT CHAIRMAN† (Dr. A. B. Everest) said how pleased the Institute was that Mr. Silvester had prepared that Paper. Members of the Institute of British Foundrymen would know that the Australian (Victoria) branch had joined the Institute within the last year or two and it was very gratifying to have association with foundry colleagues in Australia. Mr. Silvester himself was largely responsible for the link-up of the Australian (Victoria) branch with the parent Institute in this country, and it was to be regretted that he had been unable to give the Paper in person. However, Mr. Jurss, who was a member of the Council of the Australian (Victoria) branch, and who was very well qualified to present the Paper, had undertaken to do so on behalf of the Author.

MR. P. M. JURSS, introducing the Paper, first gave brief biographical particulars of Mr. Silvester and then presented a summary of the Paper. He stated that since the Paper had been written the population of Australia had passed 9,000,000. The rate of population expansion was the highest for the Western countries, being thirty times greater than that of the United Kingdom. Also, the ruling price of pig-iron had increased to A£21 per ton.

THE CHAIRMAN, opening the meeting for discussion and thanking Mr. Jurss, said it would be rather a difficult Paper to discuss and its interest and value lay rather as a record of what had been done and what was envisaged for the future in Australia.

Problems of Location

MR. J. H. OSBORN said that during a recent visit to Australia he had seen many foundries, and had visited several friends in Melbourne who were members of the Australian (Victoria) branch of the Institute. In his opinion, Mr. Silvester's Paper gave a comprehensive account of the Australian foundry industry at the present time, but he particularly wished to stress the problems of location, as few people in England appreciated the vast size of Australia. There were only about half-a-dozen heavily-populated industrialized areas in Australia, and having travelled between several of these centres by car, he was well aware of the distances which separated them. There was some local industry in country districts, where the securing of supplies of water and power presented very real problems which few who lived in cities were readily acquainted with. Whyalla, for example, was an isolated locality in south Australia, close to one of the main sources of iron ore, and had its own blast furnaces, shipyards, and steel melting plant. Nevertheless, its very remoteness had created a demand for a wide range of castings for use as spares and replacements. He was particularly impressed by the ingenuity which had been applied there, particularly with regard to the manufacturing of manganese-steel castings.

Many foundries in the heavily industrialized areas had been visited by him, and their products examined; whilst in some instances he had had the opportunity of sampling the finished article. The General Motors' Holden car provided such an example, as he had owned one throughout his visit. It was a first-class car, well able to stand up to the rough treatment on the Australian roads. (This was not intended as condemnation of the Australian roads, which, bearing in mind the sparseness of population and distance involved, were extremely good, but as yet it had been possible to tarmac only the surfaces of the major roads, and some of the city streets.)

Corebinder Usage

In all the foundries he had visited he had found that cereal corebinders were used extensively, whilst core-block moulding was applied on a much greater scale than was customary in this country. He would like to know whether this was the case throughout Australia, or whether, merely, it was chance that had brought him to the few foundries extensively using core-block moulding techniques.

MR. JURSS, in reply, said the use of corebinders in Australia was very extensive and Mr. Osborn's observation was therefore correct. The dry-sand method of moulding had been exploited there as he could well imagine it had been exploited in this country. The trend had been away from ordinary sands towards synthetic sands, and the development of corebinders had facilitated that to a great extent.

MR. WALTER R. JAESCHKE said Mr. Silvester was to be complimented on such a wonderful compilation of the history of Australian progress and Mr. Jurss on his excellent presentation of the Paper.

* Paper printed in the JOURNAL, August 18 and 25, 1955.
† The chair at this session was occupied jointly by Dr. A. B. Everest and Mr. W. R. Jaeschke, the latter representing the American Foundrymen's Society.

The Foundry Industry in Australia

It was most interesting to hear of progress in remote places, and those engaged in international committee work hoped that some of it was due to their work, but undoubtedly one had to give the pioneers in Australia much personal credit for the progress they were making. As Mr. Steele had mentioned earlier in the Congress, when one lacked proper tools one had to use one's brains, and it looked as though those pioneers had the brains required to make progress in those countries. It was particularly encouraging to see such advancement recorded, it made for a better future for the world as a whole and would bring nations closer together.

Competitive Position

A MEMBER expressed his delight at the Paper and said he had found particularly interesting the remarks made by Mr. Jurss, which bore out the fact of the high cost of production in Australia. On the other hand, his own company had recently encountered competition from Australia and he was wondering how a steel company out there could make steel valve-castings for the oil industry, ship them to this country, and sell them at prices below those which ruled for this country from the main steel foundries. The valve castings in question were excellent in quality and were equal in finish to those produced by any steel foundry in this country, including his own, and not one of them had failed on test. The Australian company had over here a representative who went round the country twice a year and without question accepted all scrap and gave full credit value for it.

MR. JURSS, in reply, said he would not like to hazard a guess as to how castings could be produced cheaper in Australia than in this country, but possibly it was something to do with an endeavour to find new export markets. Australia's problem was that wool had been of such high value they had all naturally been "riding on the sheep's back" and had lived very well. However, with the advent of the drop in the wool prices some other export had to be found. The castings might possibly have been produced at a loss, but as for the quality, he felt sure Australia had the means to produce castings second to none.

DR. A. B. EVEREST then asked whether the fact that the Australian pound had a different value as compared to the pound sterling might have a bearing on the matter of relative costs.

MR. JURSS replied that Australia was at a 25 per cent. discount to sterling, *i.e.*, £1 Australian was only worth 15s. sterling, and that might affect relative costs.

Concluding the discussion, the CHAIRMAN proposed a very sincere vote of thanks to Mr. Silvester for his survey and to Mr. Jurss for the excellent way in which he had presented it, and also asked Mr. Jurss, when he returned to Australia, to take back to Mr. Silvester and the Council of the Australian (Victoria) branch the parent Institute's most sincere greetings and to say that the latter looked forward to seeing more of their Australian colleagues at future congresses.

The vote of thanks was accorded with acclamation.

MR. JURSS, replying, took the opportunity of extending to the Institute of British Foundrymen greetings on behalf of Institute members in Australia. He had been delighted to have the opportunity to be present at the Congress and wished particularly to commend officials of the Institute in this country on the wonderful planning that had gone into its organization.

"Metallurgical Coke in Lorraine"

Blending and Ramming the Charge

The use of coals of poor coking quality for the production of metallurgical coke with particular reference to the use of Lorraine coals, was discussed by M. Moussu before the Joint Metallurgical Societies' meeting in Paris recently.

As is generally known, about 75 per cent. of the French iron and steel industry is concentrated in Lorraine, although until recent years only the ore was used, the local coal as mined, being unsuitable for making metallurgical coke. A solution of this problem, however, by blending and other treatment has been continuously sought, but only comparatively recently with success.

Lorraine coals have a high volatile content of between 35 and 40 per cent., and carbonized alone by conventional methods produce coke whose physical properties render it unsuitable for use in the blast furnace, or even for many industrial purposes. The apparent density of the coal alone in the charge does not reach more than about half the true density of the solid coal; and as one of the characteristics of Lorraine coal is that it does not swell during carbonization, the coke is porous and friable. A first essential has been to increase the density of the charge. The most effective method of doing this is by ramming. Other means of attaining this include dry charging and judicious sizing.

At the metallurgical coking plant, Thionville, the "Sovaco" process adopted is based upon the petrographic nature and grain-size of the charge. Coal is a heterogeneous substance comprising at least four petrographic constituents whose coking properties for a given coal are not the same. Therefore, this process employs the principle of blending Lorraine coals with other bituminous and semi-bituminous grades. Another concern in the area employs the ramming principle, using a high proportion of Lorraine coal amounting to some 65 per cent. when blended with long-flame bituminous coals. The Carling coking plant of this undertaking initiated a process in which the charge includes an addition of bituminous coal having a low-volatile content, and a moderate addition of coke breeze crushed to between 2 and 10 mm. It is of interest to note that from the end of this year, according to the author, about 35 per cent. of the coke produced in Lorraine will be made by this process.

Modern Patternmaking Establishment

New Works of Universal Pattern Company (London), Limited

Developments within the foundry and engineering industries in recent years to meet demands for increased output at lower cost, yet for products of an increasingly complicated nature, have been vigorously supported by expanding the capacity and ability of pattern and equipment suppliers to statisfy requirements. A good example of a pattern-engineering concern, which in its evolution and policy has kept pace with events, is the Universal Pattern Company (London), Limited, which recently established new workshops in a modern factory building on the industrial estate at Crawley, Sussex. This works is described in what follows.

The firm had its beginnings in the establishment of a modest master patternshop by Mr. N. C. Fisher in 1938, catering for the needs of local industry in the supply of miscellaneous models and patterns. High standards of workmanship, coupled with an enlightened conception of modern requirements, planted the seeds for the subsequent steady growth in the affairs of the business, technically and commercially. A significant rôle was played during the war, the character and strength of the firm being properly consolidated, but, as in many companies, the real challenge arose in the post-war years, when the drive for industrial expansion and exports on a competitive commercial basis gained momentum.

Evolutionary Progress

Larger and more promising premises were taken in the heavily industrialized district of Bermondsey, London. This first of all absorbed the increasing business in general patternmaking and later permitted a significant development in the manufacture of models and patterns for the automobile-body industries, a form of business requiring a strong technical organization and ample craft skills.

It was a logical and inevitable step from the high standard wooden pattern- and model-making, in which the firm had established itself, to serious entry into the field of metal patternmaking and foundry tooling. Extensions in the Bermondsey premises were made to accommodate the additional machinery installed to support this new development. It was quickly realized that only with capacity to provide precision, fully-machined equipment, having behind it good design and modern conception, would any worthwhile headway in this industry be achieved and consequently the heaviest possible investments were made in machine tools and apparatus coupled with a careful recruitment of personnel. This policy—and its proper day-to-day execution—subsequently yielded a considerable output of modern metal equipment for motor and jet-

FIG. 1.—*General view of the new woodworking shop at the Universal Pattern Company (London), Limited.*

FIG. 2.—*Section of the metal-patternmaking department at the Crawley works.*

engine castings and research models, foundry jigs and tooling, etc., which gained the company a sound reputation in this class of work. From the restrictive effect of coping with an expanding business in inadequate premises emanated the desire for greater manufacturing capacity and an opportunity was seized to acquire space and facilities in keeping with the company's progress when the establishment of the modern industrial estate at Crawley, Sussex, took place.

Move to Crawley

From the outset, bearing in mind the technical evolution of the company and the current demand for its products and services, the new factory at Crawley was planned in detail and conception with considerable foresight. This factory was occupied by most of the Bermondsey personnel, together with new recruits in April of this year and is now a fully-integrated wood- and metal-pattern and tool-engineering unit, well equipped to meet the future trends in the mass-production industries.

The old works at Bermondsey still function, reduced in capacity, as a wooden master-pattern shop, to cater for mostly local demands. Also, a nucleus foundry, which has been in operation for some time in the making of pattern castings, is under development as a specialized light-alloy foundry. Here, pressure-cast, plaster-moulded pattern castings are made regularly and plaster moulding of specialized castings is in hand.

The new premises at Crawley occupy an area of 32,000 sq. ft., divided between a woodworking shop (Fig. 1) and a metal shop (Fig. 2). Every function

FIG. 3.—*Group of metal pattern and corebox equipment produced in the new shop.*

FIG. 4.—*Vernier height gauge being used in the inspection department to check a large and intricate pattern.*

of works organization and production, administration and welfare is individually provided for. Incoming materials and outgoing products are handled at the rear of the shops, where fully equpped and modernized storage facilities are located. Administrative offices, welfare and canteen blocks flank the works on two sides and an efficient control and supervisory office is centralized between the workshops.

Wooden-patterns Section.

The shop where wooden patterns are made is characterized by an orderly and efficient layout comprising parallel lines of benches and a strategic positioning of a wide range of woodworking and patternmaking machinery, properly related to the storage of rough timber. This layout, and the abundant facilities for production, are coupled with amenities to ensure encouraging working conditions. The shop is regularly engaged in the producton of first-class equipment for the heavy engineering, marine, aircraft and motor industries.

Metal-pattern Department.

The increasing complexity and accuracy of metal-pattern and foundry production equipment necessitates resources more akin to the modern engineering tool-room than the traditional metal patternshop and this department at Crawley well demonstrates this. Here, a very large investment has been made in machine tools and equipment—notable examples are the copy milling and universal milling machines, shown in Fig. 2 (which are specially selected for the size of job that can be traversed by the milling head), precision lathes, cylindrical and surface grinders, precision borers, etc. An appreciable proportion of the patterns and coreboxes made are of the fully-machined type in cast iron, steel or brass, a group of which is shown in Fig. 3. In this category are dies for gravity-die-casting and pressure-die-casting, the manufacture of which form a part of the firm's activity. Also in hand are models for precision investment moulding and dies for wax-pattern production.

Designing and Planning

One of the most notable features of the firm is the comprehensive design and planning drawing-office. It is very well equipped and a staff of fourteen draughtsmen and designers is employed in it. The best utilization of the excellent machine-tool resources in the patternshop is only possible through the detailed planning and drawing of the simple elements in any particular job, thus avoiding errors —both reducing the responsibility of the individual patternmaker and assisting in the rapid completion of a project. The works is, therefore, regularly engaged in the manufacture of metal equipment for foundries for which purpose it produces its own designs or co-operates closely with the pattern-design departments of the larger mechanized foundries. Key members of the staff are experienced foundry engineers giving leadership in the prescription of the most-up-to-date methods and in the design of production equipment covering machine moulding, coreblowing, shell moulding, core-assembly and closing fixtures, inspection devices, spot-location fixtures, and so on. A section of the drawing office is devoted to jig-and-tool design for manufacture in the firm's own shops or by clients themselves. In addition, the unit is skilled in the design of gravity-casting dies of which a number are made for the foundry at Bermondsey.

Inspection and Standards Section

A modern inspection department is a significant component in the system of working at the Crawley factory. The large variety of complex precision equipment undertaken could not, of course, be handled without this. Consequently, nothing has been spared to provide the proper range and type of apparatus required for checking, notable amongst which are comparators and a profile projector. This inspection department (Fig. 4) is fully approved for AID and ARB inspection procedure.

After examining this new works and the projects in hand one is left with a firm conception of an example of a model pattern engineering organization, conducted in all the aspects of design, craftsmanship, production, customer-liaison, good-housekeeping and welfare with fastidious thoroughness and adequately equipped in all departments to meet the demands generated by the most revolutionary foundry developments.

AN ISRAELI DELEGATION of transport specialists recently signed a contract with the British company Leyland Motors, Limited, for 250 bus chassis, estimated at a cost of £1,000,000.

Company News

SAUNDERS VALVE COMPANY, LIMITED—Subject to CIC consent, the directors propose to capitalize £50,000 of share premium account and issue one share for every six held. Such shares will not rank for the declared interim.

FISHER & LUDLOW, LIMITED, makers of metal pressings, etc., of Birmingham—In his statement, the chairman, Mr. Arthur Keats, says that considerable sums are being spent on further expansion of buildings and plant for press shop, toolroom, and body assembly.

CRONITE FOUNDRY COMPANY, LIMITED—A final dividend of 23 per cent. now recommended makes, with the 12 per cent. interim, a total of 35 per cent. for 1954-55, as compared with 30 per cent. expected when the company sought a London Stock Exchange quotation last June.

CONSETT IRON COMPANY, LIMITED—The manufacturing and trading margin has more than doubled, at £1,999,131, for the 52 weeks ended October 1, 1955, compared with £869,189 for the previous period. Net income, before tax, has risen from £874,127 to £2,071,309 and, after tax, from £554,393 to £1,030,243.

METAL AGENCIES COMPANY, LIMITED—A rights offer to raise approximately £250,000 is announced by the directors. Ordinary stockholders registered on December 8 will be offered 939,790 5s. ordinary shares at 5s. 6d. each in the proportion of one for every two 5s. units held. Following the 5 per cent. interim dividend the directors expect to pay a final of 11 per cent.

LAPORTE INDUSTRIES, LIMITED—Acceptances following the offer to ordinary stockholders of 3,245,897 5s. ordinary shares at 12s. 6d. per share totalled over 98 per cent. Applications for additional shares amounted to more than 20 times the number of shares available. Up to 20 shares applications were allotted in full, and those for more than 20 shares were allotted 20 shares each.

SIDNEY FLAVEL & COMPANY, LIMITED, gas-appliance manufacturers, of Leamington Spa (Warwickshire)—The directors recommend a final dividend of 4 per cent., to make 10 per cent. for the year ended July 31. For the previous year a 9 per cent. final made a 15 per cent. total. After tax, etc., the net profit of £39,779 compares with £79,107 in 1953-54. It is proposed to increase the capital to £750,000 by the creation of 1,250,000 new 4s. shares.

RICHARDSONS WESTGARTH & COMPANY, LIMITED—An extra-ordinary meeting is called for December 14 to increase the capital by £2,000,000 by the creation of 8,000,000 new shares of 5s. each. It is stated that the company has no plans for issuing any further capital, but in order to obtain the maximum relief from capital duty on the increases in the issued capitals of the operating companies, it is necessary also to increase the authorized capital of the parent company.

FERRANTI, LIMITED, manufacturing electrical engineers, of Hollinwood (Lancs)—The directors are of the opinion that "it would not be in the best interests of the company to provide for their increasing financial requirements by raising additional capital on a permanent basis under present conditions." They therefore propose "to continue to avail themselves of the facilities placed at the company's disposal by its bankers" and are calling a meeting for December 15 to increase borrowing powers to £7,000,000 or the total of capital, reserves, and surplus, whichever is greater. On the basis of the balance-sheet of March last, the limit of £7,000,000 would operate.

Parliamentary

Health Hazards in Industry

Replying to DR. BARNETT STROSS (Lab.) who asked which industries were considered to bear serious health hazards for which the Industrial Health Advisory Committee had recommended voluntary medical supervision, the MINISTER OF LABOUR (Sir Walter Monckton) said the committee had recommended the stimulation of the further development of voluntary medical supervision in the steelfoundry, iron and steel manufacturing, rubber, and chemical industries.

DR. STROSS asked if there could not be an extension to all industries in which noxious fumes and dusts were inhaled by workers, and would the Minister bear in mind that in copper smelting foundries cadmium was sometimes used and the fumes from it were now known to be quite deadly in their effect.

SIR WALTER MONCKTON: "I will bring that to the notice of the committee so far as the committee is not already aware of it."

In a further question, DR. STROSS said that many employers and workers still mistakenly believed that industrial dermatitis was contagious. He asked if the Minister was satisfied that the officers in employment exchanges were fully aware that there was no such possibility of infection and what steps would be taken in the campaign against dermatitis.

SIR WALTER said he was aware that misapprehension about industrial dermatitis might still exist among some employers and workers, although the position was made clear in a poster issued by his factory department. He was satisfied that the officers concerned in employment exchanges with persons disabled by dermatitis were aware of the facts. The Chief Inspector of Factories had revised and reissued a leaflet and a poster containing advice on prevention, and further measures to stimulate the interest of employers and workers in the need for precautions were now under consideration. Special visits were paid to factories where dermatitis was known to be a particular problem and inquiries were being made into the risk of dermatitis from certain substances. Attention was also being paid to the problem in the course of the pilot local industrial health survey now in progress in Halifax.

Nickel Supplies

By far the greater part of our supplies of nickel came from Canada, said MR. PETER THORNEYCROFT, President of the Board of Trade. He told MR. FREDERICK LEE (Lab.) that there is a world shortage of the metal.

The Minister said that some manufacturers were getting less than they could use, and were unable to build up stocks. Manufacturers were buying increasing quantities of nickel from other sources, mainly from New Caledonia, but the amounts obtainable were comparatively small.

Furnace Bricklayer's Claim Rejected

The Court of Appeal has rejected the appeal of Gerald Aylmer Edwards (40), a bricklayer, of Meadow Lane, Porthcawl, whose left eye was injured while he was at work in a furnace, against the dismissal by Mr. Justice Sellers at Swansea Assizes of his claim for damages from his employers, the Steel Company of Wales, Limited. On February 5, 1954, Edwards was cutting out firebricks in the company's Abbey Works at Port Talbot, and a fragment of metal from a bar he was using struck his cheek and eye when the bar was hit with a hammer.

A Jobbing Investment Foundry in South Africa*

Discussion of the Exchange Paper from the IBF South African Branch

In the discussion, the Author was warmly congratulated on operating such a pioneer process in South Africa. Questions were designed to elucidate detail features of the methods described—crucible composition operating methods, carbon pick-up, and economics came within this category.

The Exchange Paper from the South African branch of the Institute of British Foundrymen, entitled "A Jobbing Investment Foundry in South Africa," by J. Steele, was presented on his behalf by Mr. Dunlop at the International Foundry Congress in London.

THE CHAIRMAN (Dr. A. B. Everest), opening the discussion which followed the reading of an abstract of the Paper, said he was particularly pleased to have that contribution from the South African branch, especially as it dealt with the sort of enterprise and improvization which foundrymen in the more remote areas had to adopt. It was undoubtedly an example of a job well done under very difficult conditions.

DR. REYNOLDS said there was probably only one justification for his speaking, that being that he was now concerned with the "Shaw process" of making castings. He was not a foundry engineer and he could not therefore comment on the "improvization" side of Mr. Steele's Paper; the technical processes in which he was much more interested were not the Paper's primary concern. He was currently using the "Shaw process" to produce castings mainly in high-alloy steels, in the weight range from a very few ounces up to the maximum melting capacity which he had available—something of the order of 150 lb. At the same time, he believed Mr. Dunlop would confirm that castings of very much larger individual weight were possible.

MR. M. G. DE ROZAS (Spain) asked of what material the crucible was made and how it was made.

MR. DUNLOP, in reply, said he did not know exactly what material was used for Mr. Steele's crucible, but in this country thousands of such crucibles were being made regularly. The material used here was dependent largely on what was being melted; for stainless steel alumina was very satisfactory; sillimanite could also be used, but it was possibly not just as good as alumina.

Methods of Working

MR. ARMITAGE said Mr. Steele was to be congratulated on his ingenuity in devising the plant described in such a remote area. At the best of times, the development of investment casting was a difficult business. He had been trying to follow the first paragraph in Mr. Steele's introduction: "Although the lost-wax process was not at first envisaged, nevertheless, the principle underlying the establishment of an investment foundry in South Africa was the repetitive production of small castings." What he understood from that was that the Shaw-Osborn process was started as an intermediate stage for close-tolerance castings, where pattern equipment and not wax was used, and that probably the next stage in development in order to produce parts at the lower weight range of the scale and more complex castings was to adopt the lost-wax process.

Referring to the description given of Fig. 3 . . . "a close-up view of the moulding section of the foundry. The moulding board is hinged at the back, a device which serves two main purposes: first, it forms a simple but effective vibrating table (should this be required) for compacting the investment. Second, as it can be set at any desired angle in one direction, patterns which are thicker at one side than the other can be moulded at an angle . . . ", Mr. Armitage said he could not see from the illustration how that was possible.

Finally, he would like to direct a question to qualified metallurgists in the audience, to learn their reaction to stainless-steel castings containing up to 0.4 per cent. carbon. Mr. Steele had said that he had done very well with them, but he thought if that were suggested in this country there might be trouble.

MR. DUNLOP, in reply to the last question, said Mr. Steele was very conscious of the undesirability of such carbon pick-up but, as was stated in the Paper, contract work was undertaken by his company prior to the receipt of melting equipment from abroad and when the melting equipment arrived it was just impossible to make it work and so the firm was confronted with orders that had to be met. They had therefore attempted to make the castings required by using the two forced-draught coke-fired pit furnaces, with the result that carbon pick-up had occurred. The castings were submitted for testing and were found to be satisfactory, so the firm had completed the order. However, as was explained, more-conventional and better melting equipment was now in process of being installed.

With regard to Fig. 3, in making a "Shaw-process" mould it was quite unnecessary to vibrate in the generally accepted sense of the word. No vibration such as was usual in the lost-wax investment process was necessary and a very common method was for the operator to bump the board three or four times after filling, so Mr. Steele had hinged his table and when the mould was on the table he "vibrated" it three or four times in this way. If he was making a casting where it would be expensive to make the whole shape he tilted the mould

* Paper printed in the JOURNAL, November 17.

at an angle and used the board for that purpose.

Referring to the lost-wax process, Mr. Dunlop said he did not think the company had first envisaged casting by this process, but since the Paper had been written he understood Mr. Steele was doing lost-wax casting elsewhere, so probably he had been referring to that.

MR. ARMITAGE said the " Shaw process," as he understood it, did not involve the use of wax patterns: for with a sand-to-sand joint for the two halves the former one had a fairly simple pattern on which to invest directly but in the lost-wax process one could make a very complex wax pattern with practically no visible parting line which one could completely surround when investing.

Processes Explained

MR. DUNLOP, further replying, said in making a casting by the lost-wax process one had a multi-piece die to produce a one-piece model which was expendable: in the " Shaw process " one had a non-expendable model and then made a multi-piece refractory mould. He would agree that for the smaller range of castings, if the quantity justified the making of die equipment, the lost-wax process might be the better method of manufacture. It was not claimed that the " Shaw process " was universal in application. As had been pointed out earlier that day,† there were many processes available, giving various degrees of accuracy and surface finish and covering various sizes of castings from a few ounces to many hundredweights, and the skill lay in selecting the right process for the job. Steel castings had been made by the " Shaw process " up to 600 lb. individual weight as a regular job, and one company making iron castings had gone as high as 11½ cwt. Technically there was no limit to size.

MR. F. A. MARTIN said he had not much of technical value to add although he could claim to have experience of the process for a greater length of time than most others, starting when it had the original name of the Shaw-Osborn process. He, the speaker, had seen the foundry in South Africa in 1941. At that time, Mr. Steele was not working on the investment process at all but was beginning to get down to all types of precision casting. He was operating the shell-moulding process out there when people in this country were only talking about it, and he had not been afraid to tackle the job.

Economics

One question which he would like to ask was with regard to economics—Ethyl-silicate was expensive and he was not quite sure how Mr. Steele managed a casting weighing 193 lb. on an economical basis. Possibly he did not, but in any case he was doing an extremely good job out there and the Institute, he was sure, was proud to number him among its members.

MR. DUNLOP, in reply to the question on economics, said that many foundries were using ethyl-silicate as a binder, selling their castings, and making a profit. He agreed that the moulding material plus the binding liquid was expensive but at the present time work was being carried out on techniques, where, on big moulds, one only used ¼-in. thickness of the more-expensive material.

MR. J. H. OSBORN also congratulated Mr. Steele on the way he had tackled a technique, which had been known in this country for over ten years. He confirmed that initiative and thought were essential if the process was to be applied effectively. South Africa provided ideal scope for the process, because many normal manufacturing facilities were in many instances not available, and unorthodox techniques had to be found to overcome day-to-day emergencies. The Shaw-Osborn process, as it was originally called, provided a means of casting difficult items required as spares or replacements at short notice. In South Africa, the price such a service could demand was high.

Requirements

To operate the process, regular supplies of a special Silester casting solution were necessary. This solution would only keep for two or three weeks. In this country, transport from a supplier presented few problems compared with those that had to be overcome in South Africa. It would be interesting to know how readily raw materials, including sillimanite, could be obtained for operating the process in South Africa.

As regards application, his own company had found that they could produce difficult castings by the Shaw-Osborn process, which could not be tackled by normal foundry techniques. Such castings had presented many problems, but they had been rewarded by the high market price which such a product could command. The Osborn-Shaw process was costly to operate, but there was a place for it alongside the CO_2 Process and other new processes. Nevertheless, these other processes might in time severely restrict the field unless the first named could be made less costly to operate.

MR. D. F. BAILEY asked what Mr. Dunlop considered would be the application of the Shaw process for making shell-moulding patterns in iron and gunmetal. In reviewing the Paper Mr. Dunlop had mentioned accuracy limits of ±0.005 in. per inch. He did not know whether those were intended to refer to small castings, but if one had a casting 10-in. long the accuracy then would not be good enough.

MR. DUNLOP, in reply, said the accuracy possible was ±0.005 in. on dimensions up to 3-in. and beyond that an overall tolerance of ±0.015 in.; he made that statement knowing that such limits could be met easily. With regard to furnishing patterns and coreboxes for shell moulding he did not know a better method than the one being discussed, and the process was being used to produce such equipment at a very economic price.

A Pilot Plant

MR. SHAW said he did not intend to speak on the technical side, but felt he perhaps ought to reply to one or two of the questions relating to the par-

† During the discussion of the American Exchange Paper " Evaluation of Casting Processes " by Hiram Brown, B.S.

ticular plant in South Africa, about which he had possibly more information than anybody else. The ethyl-silicate question which had been raised was, of course, essentially answered in the Paper, but he ought to make clear the fact that the initial purpose of establishing the unit to which Mr. Steele had referred was to encourage other people in South Africa to use the process. The price of ethyl-silicate certainly was a matter of major importance in the process, and until usage increased, there could be no early prospect of i[illegible] indeed quite reasonable. [illegible] rather complex process. [illegible] the future lay in the deve[illegible] Mr. Dunlop, *i.e.*, in using [illegible] every part of the mould where[illegible] was unnecessary.

pneumatic system of implement underslung.
of Samuel Spencer, Limited, he old shipyard at Trench beltown loch. The deal es, Limited, who have ast 10 years. There yard is to be put.

On the motion of the CHAIRMAN[illegible]ns & Company, of thanks was accorded to Mr. Steele [illegible]dded two new and to Mr. Dunlop for presenting it. [illegible]nd this has [illegible]cing high- [illegible]d rotary

Hot-tinning of Cast Iron*

By C. J. Thwaites, B.Sc., A.R.S.M.

[Abridged]

Cast iron has always been considered to be a rather difficult material to tin by the hot-dipping process. The difficulty arises from the presence of graphite in the structure of cast iron which can appear as outcrops or smears at the surface. Broadly speaking, suitable preparation procedures aim either at removing surface graphite, or at covering it over with a readily-tinned metal. Such processes as the Kolene process and the T.R.I. fused-nitrate process remove the graphite by oxidation. The second category of processes involves plating with pure iron or copper prior to tinning.

During the war years, efforts to discover a less-complicated procedure for a specific task, resulted in the development of the T.R.I. fused-chloride process. In this procedure, surface graphite is partially removed by grit-blasting and the surface is finally prepared by a short immersion in a eutectic mixture of sodium and zinc chlorides at about 300 deg. C. The use of fused chlorides instead of acid for final pickling effectively prevents graphite smear.

Recent Modification

More recently, a modification of this procedure, which is called the *direct-chloride method*, has proved very successful in certain applications. The method was first developed for certain high-phosphorus irons found not to be amenable to tinning by the fused-chloride salt-bath method due to their susceptibility to over-treatment. It has since been found to be generally applicable to grey cast irons and has been used successfully for Meehanite and spheroidal-graphite irons.

The method may be found particularly useful for articles of very varying section where, with the fused-chloride process, over-treatment of the thinner sections is always a difficulty unless pre-heating is used. It depends for its success on careful and complete grit-blasting of every portion of the surface to be tinned. The operations to be carried out on the castings are:—

1. Blast thoroughly with No. 70 angular steel grit, *i.e.*, grit which passes a 70-mesh per in.

2. Degrease by the trichlorethylene-vapour method. If a very smooth surface is essential, a water-barrelling operation may be insert[illegible] high- this stage.

3. Dip in aqueous flux of following composition:—

Zinc chloride	24 lb.
Sodium chloride	6 lb.
Ammonium chloride	3 lb.
Hydrochloric acid	2 pints
Water	10 gall. (100 lb.)

All surfaces of the casting must be wetted by the flux. Delay between operations (1) and and (3) should be kept as short as possible.

4. The casting is then lowered slowly into the first tinning pot, the surface of which is covered by a layer of flux at least one inch thick.

The flux contains—Zinc chloride, 8 parts: sodium chloride, 2 parts; and ammonium chloride, 1 part, and must be kept in a freely ebullient condition by frequent additions of water.

With large articles, which must necessarily be immersed rather slowly, there may be some risk of drying of the aqueous flux on the upper parts before immersion is complete. This will inevitably lead to imperfect tinning and must be prevented by spraying with water or an aqueous flux-solution from a fine rose or any simple spray gun. The temperature of the tin should be in the range 300 deg. to 320 deg. C.

5. Although the piece should accept the tin within about one min., it is advisable to allow a "dwell" in the tin-pot of at least 5 min. This prolongation of time allows escape of flux residues and greatly minimizes risk of "sweating" in the finished coating.

6. After removal from the first tin-pot, subsequent tinning and manipulating operations are as normally practised.

Although the direct-chloride process has been used mostly for providing tin coatings for protection, some information is available on expected adhesion values when the method is used as preliminary to bonding Babbitt alloys to cast iron. As good or somewhat better adhesion figures than those usual for the fused-chloride process should be obtained, and about 2 tons per sq. in. is a reasonable expectation. This figures is admittedly not as good as that obtainable by the graphite-oxidation processes, but such processes are, of course, more complicated.

* From *Tin and its Uses.*

New Patents

(Copies of complete specifications are obtainable from the Patent Office Sales Branch, 25, Southampton Buildings, Chancery Lane, London, W.C.2, price 3s.)

740,301. Goldschmidt Aktiengesellschaft, 15 Heilermannstrasse, Essen, Germany.

A method of improving the useful properties of flints of mischmetal (cerium) iron alloys, which contain between 10 and 30 per cent. iron with or without alloying additions after casting. The mischmetal (cerium)/iron alloy is subjected to annealing at temperatures between 100 deg. C. and the temperature at which melting begins, preferably between 350 and 450 deg. C. for a period of between 5 and 24 hours. The alloy should then be allowed to cool to room temperature.

740,323. Rolf Erhard Moren, Alfredshen, Sweden, and L. H. V. Villner, Kinnekullevagen 19, Bromma, Sweden.

A method of making moulds, and particularly cores, for metal casting, which consists of forming the mould element from sand using a binder in the form of a water-soluble cellulose derivative and baking the element at least in part by dielectric means. A typical example of a sand mix would be (by weight), 100 parts of sand, 1.5 parts of ethyl hydroxyethyl cellulose and water 6 per cent. of the total compositions and including moisture content of sand. This type of binder is claimed to have good " green " and dry strengths.

740,352. Colvilles, Limited, 195, West George Street, Glasgow, C.2.

A low-carbon steel which consists of carbon 0.03 to 0.02; vanadium 0.05 to 0.4; molybdenum 0.10 to 1.0; manganese 0.3 to 1.0; titanium 0.05 to 0.5 per cent. The balance apart from impurities being iron. This steel is particularly suitable for chromizing, with a high creep-resistance at low temperatures, for manufacture into boiler or superheater tubes. " Chromizing " is the diffusion of chromium into the surface of a metallic article by any method in which the article is brought into contact with chromium or fluid chromium compound at a high temperature.

740,353. Compagnie Générale des Conduites D'eau, Les Vennes, Liège, Belgium.

A process for the manufacture of Thomas or basic steel. Pig-iron having a high-sulphur content and a low-manganese content is produced in a blast furnace from low-acid ores by an acid process. It is then re-treated in a hot-blast cupola, under reducing conditions, with a quantity of fuel in excess of that required for melting, and a correspondingly high quantity of basic slag. The iron is superheated to between 1,500 and 1,600 deg. C. It has a constant composition with a low content of S and Si, and a content of C., Mn., and P, at least equal to the starting material. The iron is blown directly in the basic convertor and refined into steel.

740,492. Societa Lorni Lubatti, Via Castelnuvo 22, Turin, Italy.

A method for the reduction of oxidic ores and oxide-containing metals by heating them out of contact with the flames of combustion. A furnace for carrying out this process is described in detail.

740,547. Deutsche Edelstahlwerke Aktiengesellschaft, 578, Gladbacherstrasse, Krefeld, Germany, and Gesellschaft für Elektrometallurgie m.b.H., 56, Grafenberger, Allee, Dusseldorf, Germany.

A process for the production of carbides of tungsten, molybdenum, vanadium, titanium, tantalum, niobium, chromium, or boron., by an exothermic method instead of the complicated chemical means usually employed.

Salvage in Industry

Recent trends in industrial development in this country show very clearly the need to export goods in which the content of British skill, labour, and craftsmanship is high enough to compensate for shortages of raw material. The need to appreciate the importance of productivity, in respect of both labour and utilization of materials, machinery, fuel management, skill, capital, and all other input factors of industry is also stressed. It is not merely a case of not wasting materials, but also of making the utmost use of what we have, particularly of scarce materials such as selenium, of which the total world supply is not great, but which is being used increasingly in the production of specialized equipment for export.

The importance of the work of industrial salvage and recovery in the interests of the national economy was emphasized by Dr. Alexander King, chief scientific officer of the intelligence division of the Department of Scientific and Industrial Research, in an address to the conference of the National Industrial Salvage and Recovery Council. Mr. King pointed out however, that productivity in the utilization of materials was equally important to the industrial firm. There were probably still quite a number of instances where large amounts of waste material of considerable potential value were not being put to use. This was due sometimes to lack of liaison between the various industries, sometimes to the lack of financial support for the necessary investigations. The time was propitious for increasing interest in the subject.

Qualcast Appointments

Promotion to departmental directorships of the first seven trainee directors selected under a scheme started seven years ago is announced by Qualcast, Limited, Derby. The directors who now take responsibility for their respective departments are:—Mr. H. A. Redshaw (foundries), Mr. M. A. Wardle (deputy to Mr. H. A. Redshaw), Mr. H. Clarke (works management), Mr. J. Higgins (production of all finished products), Mr. E. J. Appleby (secretarial and statistics), Mr. R. Harris (sales), and Mr. H. U. Redshaw (mobile, at present at the Australian plant).

Four of the new departmental directors have also been appointed as alternates to members of the main board, the alternate director in the case of Mr. J. E. V. Jobson, chairman and managing director, being Mr. H. Clarke; Mr. R. Harris for Mr. T. W. Cooper, Mr. H. A. Redshaw for Mr. J. R. Fleming, and Mr. E. J. Appleby for Mr. D. McMillan.

Contracts Open

The dates given are the latest on which tenders will be accepted. The addresses are those from which forms of tender may be obtained. Details of tenders with the reference ESB can be obtained from the Board of Trade Export Services Branch, Lacon House, Theobalds Road, London, W.C.1 (telephone: CHAncery 4411, ext. 738 or 771), unless otherwise stated.

CHILE, December 20—Rails, fishplates, tieplates, anchors, and compromise joints, for the Chilean State Railways. (ESB/25764/55.)

NORTHWOOD (MIDDX), January 7—Castings for the year commencing April 1, 1956, for the Urban District of Ruislip-Northwood. The Engineer and Surveyor, Council Offices, Northwood.

SYRIA, December 27—Materials for water mains at Latakia Harbour, for the Latakia Port Company. (ESB/25230/55.)

SOUTHERN RHODESIA, January 4—Sleeper-end bolts and washers, for the Rhodesia Railways. (ESB/25048/55.)

News in Brief

A £40,000 diesel test-house is to be built nearby the Derby Locomotive Works, by British Railways.

THE CONTENTS of James Watt's workshop are on public view again in the Science Museum, South Kensington.

THE SIXTIETH ANNUAL MEETING of the American Foundrymen's Society is to be held in Atlantic City, from May 3 to 9, next year.

THE ADDRESS of Mitchell Engineering, Limited, is now The Bridge, Peterborough (Northants). The telephone number is unchanged.

GUY MOTORS AFRICA (PTY.), LIMITED, has placed a contract for the erection of premises in Johannesburg and another for the purchase of land in Rhodesia.

AMERICAN STEEL FOUNDRIES announce that in future all invoices and correspondence should be addressed to them at Prudential Plasa, Chicago, 1, Illinois, USA.

DIESEL ENGINES for a Canadian tractor will be supplied by F. Perkins, Limited, Peterborough, under a contract which it has secured worth $1,000,000 (£350,000).

"BAKERS" foundry of Compton, Berkshire, is to be re-opened in January, 1956, for the production of iron castings by a new company—the B.H. & C. Foundry Company.

A TWENTY-EIGHT-ACRE SITE, formerly an amusement park, at Hope Bank, Honley, has been purchased by Brook Motors, Limited, for new factory development. It is about four miles from the Huddersfield works.

DAVEY, PAXMAN & COMPANY, LIMITED, Colchester, has received an order for 20 16-cylinder, steel-framed diesel engines, valued at about £200,000, under the British Transport Commission's locomotive programme.

DORTMUND REPORTS indicated that at least six people were killed and eight seriously injured when a furnace exploded on November 25, at the Dortmund-Hörder Hütten-Union, one of Western Germany's largest steelworks.

AN ORDER for 1,100 covered railway wagons for the Pakistan Government, worth £1,500,000, has been received by the Wishaw firm of R. Y. Pickering & Company, Limited. Delivery will begin towards the end of 1956, and is expected to take about seven months.

A £3 MILLION ORDER, comprising three vessels—two cargo and one tanker—has been placed with the Blythswood Shipyard, Glasgow, by Panamanian owners. The yard has no engineering shop and the contract for the propelling machinery for the three vessels will go to local firms.

BRITISH ROAD SERVICES has placed a further order with Leyland Motors, Limited, for 24-ton gross Octopus trucks—a total of 125—to join some 600 already in service. Nearly 350 Leyland vehicles have now been ordered by BRS this year, including a fleet of Beaver and Comet tractors.

ASSOCIATED ELECTRICAL INDUSTRIES, LIMITED, has disposed of its holding of 834,697 shares in Westland Aircraft, Limited, Yeovil. The sale, it is stated, has taken place in accordance with the policy of AEI, which is not to hold permanently shares in companies outside its normal activities.

DAVID BROWN TRACTORS (ENGINEERING), LIMITED, Huddersfield, have produced a small cheap tractor which is their chief exhibit this year at the Smithfield Show. It is claimed that the machine is the first in the world to be fitted with a pneumatic system of implement control. All tools are underslung.

THE SOUTHAMPTON FIRM of Samuel Spencer, Limited, is reported to have bought the old shipyard at Trench Point at the entrance to Campbeltown loch. The deal was made with B.R.T. Securities, Limited, who have owned the shipyard site for the past 10 years. There is no information as to what use the yard is to be put.

THE FOUNDRY FIRM of J. Hobkirk, Sons & Company, Limited, Ampthill Road, Bedford, have added two new bays to their former non-ferrous foundry and this has now been converted into a foundry producing high-grade iron. In one of the new bays an oil-fired rotary furnace has been installed for the production of high-duty iron.

IN CONJUNCTION with seven other kindred bodies concerned with X-rays and their applications, the Royal Photographic Society is organizing an exhibition of X-ray photography from December 14 to 22, at 16, Princes Gate, S.W.7 (close to the Albert Hall) in commemoration of the discovery of X-rays by Professor W. C. Röntgen sixty years ago.

HEADQUARTERS for the new industrial tractor division of David Brown Tractors (Engineering), Limited, have been established at Feltham, Middlesex, where all home and export sales enquiries will be dealt with. A service and spares depot is also being established at Moll Spring Mills, Netherton, near Huddersfield. Mr. S. Hallam is the depot superintendent.

ABOUT 300 MEMBERS of the managerial and executive staff of Crofts Engineers (Holdings), Limited, Bradford, attended the sixth annual dinner of the company at the Midland Hotel, Bradford, on December 2. Mr. John A. Croft, deputy chairman, who deputized for his father, Sir Arthur Croft, at present in South America, said it had been a wonderful year for Crofts.

A SECOND ORDER from the Nova Scotia Light & Power Company has been placed with the English Electric Company, Limited, for a 45,000-kw, 3,600-r.p.m. steam turbo-alternator set, complete with feed heating and condensing plant, for installation at the Water Street power station in Halifax, Nova Scotia. The value of the order is approximately £450,000.

DISPLAYED in the entrance hall of the general offices of Newton Chambers & Company, Limited, at Thorncliffe, is the first ledger used by the company, which is entirely in the handwriting of George Newton, co-founder of the company. The first entry is March 2, 1793. Another exhibit is the purchase day book, showing all the material used by the company from 1822 to 1826.

A PAPER of distinct interest to manufacturers and users of gas-fired box-type furnaces was presented to the autumn meeting of the Institution of Gas Engineers. It was given by Mr. P. A. Cubbage and Dr. W. A. Simmonds. and carried the title "An Investigation of Explosion Reliefs for Industrial Drying Ovens. (1)—Reliefs in the Top of Box Ovens." A suitable design is put forward for the purpose of securing adequate pressure relief to comply with safe practice.

IN HIS ADDRESS to the Newcastle-under-Lyme Rotary Club, Mr. J. Carver, an inspector of the North Staffordshire District (Newcastle-under-Lyme) of the Mines Inspectorate, said that in 1306, although coal was burned only by artisans, so extensive was its use in London that Parliament complained to the King of the noxious vapours polluting the atmosphere. The result was that all but smiths were compelled to use other

News in Brief

fuel, lest the health of knights from the shires should suffer during their stay in London.

THE CAMPAIGN for domestic fuel-efficiency in Scotland is being stepped up by the Scottish committee of the CUC. They have formed two more joint service committees—Greenock and district and Stirling and district—bringing the total of such committees in Scotland to 10. The aim of the committees, which comprise local coal merchants and members of the CUC's panel of approved solid-fuel appliance distributors, will be to further the Coal Utilisation Council's policy of trying to secure the more efficient use of coal and other solid fuels in the home.

CONCERN about the shortage of alloy steels is expressed by Mr. Sidney Guy, chairman and managing director of Guy Motors, Limited, Wolverhampton, in a statement accompanying the firm's annual report. "We in common with others are very concerned with the shortage of alloy steels, the ever-increasing wage awards, the large increase in the cost of fuel, and their effect on the cost of supplies and production. The introduction of new plant and methods has resulted in some increases in productivity, but the increase compares unfavourably with some of the countries with whom British industry has to compete," Mr. Guy states.

DEMANDS for increased production in the motor industry have made it necessary to accelerate development by the Owen organization, Ald. A. G. B. Owen stated on December 2, at the sixth annual reunion and dinner of the organization's apprentice guild at Darlaston. He said that in the past 12 months the organization had exported well over £1 million worth of goods; they were doing even better this year and, basing the findings on figures so far, the group would have exported over £1,500,000 worth of goods by the end of the year. He added that in October alone, orders from Canada to the firm equalled the entire orders received in the previous 12 months.

BRITISH THOMSON-HOUSTON COMPANY, LIMITED, have awarded £60 to Mrs. Barbara Autherson, an employee at their works at Thorne, near Doncaster, for a suggestion which will boost production. This is the largest award given by the firm during the four years it has been at Thorne. For two and a half years Mrs. Autherson has taken 400 parts for fractional horse-power electric motors and spent considerable time in drilling holes in them to receive oil nipples, carrying them to a larger machine for another process. She submitted her idea of putting the drill close to the larger machine and drilling the oil-nipple holes while she was waiting for the previous part to be processed. The alteration has been made and she expects to be able to handle up to 100 more parts each day and the increased production will benefit both Mrs. Autherson and the firm.

Automatic Presentation Machine. Readers may well wonder just what is such a machine, just as the writer did before seeing the apparatus in operation at a Press conference. The machine is manufactured by Milford-Astor, Limited, Riverside Works, The Crescent, Salford, 5. It colour-prints show-cards, labels, tags, transfers, and the like on a wide range of materials. The transfers, when used on grinding wheels (and castings), it is suspected, should be given a coat of some sort of varnish. The output of this machine, which also cuts to shape, made a particularly attractive display of modern advertising art.

Fuel-economy Campaign

Mr. Geoffrey Lloyd, the Minister of Fuel and Power, has been suffering from a severe chill and was unable to attend two meetings in his programmed tour of the country's industrial centres to further the promotion of fuel efficiency in industry. Sir John Maud, Permanent Secretary to the Ministry, took his place in Leeds last Thursday, to address the Regional Boards for Industry for the East and West Ridings of Yorkshire. Mr. L. W. Joynson-Hicks, Parliamentary Secretary to the Ministry, who had previously held a meeting in Newcastle-upon-Tyne, deputized in Cardiff on November 29. On November 25, however, the Minister did address the North West Regional Board for Industry on the subject of fuel efficiency. At the meeting, held in Manchester, Mr. Lloyd gave an assurance that if cuts in coal supplies to industry had to be made, those companies which achieved economies in their consumption this winter would not have their allocations reduced. He added that essential supplies for the public services and the domestic consumers would be safeguarded by a planned reduction in supplies to industry.

New Gas Research Laboratories

Extensions to the Gas Council's London Research station at Fulham were officially opened on November 18 by Sir Robert Robinson, president of the British Association and a member of the Council's Research Committee. They add three more laboratories to the station and practically double the available floor area.

The additions bring the number of laboratories to seven. Of the new ones, No. 5 laboratory is the largest. Designed to accommodate big pilot plants, it covers 3,000 sq. ft. Work is already progressing on the life of refractory materials used in retorts and on the manufacture of catalyst for organic sulphur removal. In an adjoining block, No. 6 laboratory is arranged for smaller pilot plant experiments and houses apparatus used to investigate the biological oxidation of gasworks effluents.

The third of the new laboratories—No. 7—is the base of Fulham's mobile team of research workers, who cover the North Thames Gas Board's area to carry out on-the-spot tests on new or modified, full-scale installations.

Taxation Threat to Home Trade

Mr. A. S. Dick, managing director of the Standard Motor Company, speaking at the annual meeting in Coventry on November 30, said that the burden of taxation would be so great one day that the country's largest and most important exporting industry would be unable to sell its products at home. If this happened, exports would suffer also, and the effects on the nation's economy and employment would be far-reaching and tragic. He went on to say: "We are trying to counteract our constantly increasing costs by introducing new plant and equipment—we cannot afford to stay still if we are to go forward in selling in world markets, but we are in competition with large organizations with great capital resources at their disposal. We must have the most modern plant and equipment and we must also develop the domestic manufacture of a greater proportion of our products in the future."

PARKINSON & COWAN, LIMITED—Sir George Jessel will resign as chairman and from the board on December 31 in view of his other business commitments. He will be succeeded as chairman by Mr. H. P. Barker.

Mr. A. F. Tosh—Director of Summersons' Foundries Ltd.

Stands Firm for

BRITISH Quest MADE

Standard Bentonite

says that in every Foundry test Quest has proved the equal of American clays ***and it saves dollars***

Extract from a Paper read at the International Foundry Congress last June, commenting on Part II of the Paper by Middleton & White (see F.T.J., page 557, Nov. 17th.)

Bentonite "Life"

Mr. A. F. Tosh, director of Summersons' Foundries, Limited, wrote that he was much impressed by the mass of academic information and to a lesser extent by that of a practical type recorded by Middleton and White on the properties of bonding clays in part II of the Paper. During wartime, and to a lower degree since, British steelfounders relied mainly on home supplies and processing of bonding clays and it was a matter of personal regret, from a patriotic point of view, that this situation on the finding of these Authors was likely to change in favour of the American clay, even though mixtures exceeding 50 per cent. of the home-processed article were quoted as giving very good results. In support of the contention that there was more in the behaviour of a clay under actual foundry conditions than could be revealed by academic test or simulated "life" tests, recent experience of Summersons' Foundries are recorded in using Quest bentonite which is of Mediterranean (non-dollar) origin, but processed in this country :—

An extended trial of the home-processed bentonite from one supplier was made in the writer's foundry on the strict understanding that the full requirements could be met and there would be no deterioration in quality. All moulds were cast in green-sand in the firm's mechanized foundry, where a sand-reclamation plant was in use. When using Wyoming bentonite, the mixture was:—

Reclaimed sand	80 per cent
New clay-bonded sand ..	10 per cent
New silica sand	10 per cent

Each mixture was of 1,800 lb. and to each batch was added 12 lb. of bentonite, giving a green-compression strength of 7.5 to 8.5 lb. per sq. in. This mixture was continued with, but Quest was substituted for Wyoming bentonite, taking samples from each milling—this was in January, 1950. No immediate fall of green-strength was expected, owing to the amount of Wyoming bentonite already in the reclaimed sand but even after 3 months the green-strength figures remained the same, viz. 7.5 to 8.5 lb. per sq. in. The test was continued for a further 3 months and at the end of the total period no deterioration of sand properties was found. Since that time, supplies have been continuous and uniform and the quality of the foundry sand well maintained.

The experience related above is also shared by other foundries, among them being the David Brown Foundries Group, Ruston & Hornsby Ltd., Midland Motor Cylinder Co. Ltd., of the Birmid Group and Osborn Foundry & Engineering Co. Ltd.

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Personal

Mr. L. SMITH, formerly works manager of the Daimler Company, Limited, Coventry, has been appointed industrial relations officer.

Mr. J. O. HITCHCOCK, sales director of the Mond Nickel Company, Limited, was elected a member of the Institution of Mining and Metallurgy last month.

Mr. G. R. DAY, foundry manager of Barnards, Limited, Norwich, is joining the B.H. & C. Foundry Company of Compton, Berks, as director in January next.

Dr. C. E. KENNETH MEES, the well-known Kodak scientist, has retired from his position as vice-president in charge of research, after 43 years' service with the Eastman Kodak Company. He is succeeded by Dr. CYRIL J. STAUD.

Mr. JOSEPH RUSSELL, foundry manager of the NCB foundry department at Shotts, Lanarkshire, has retired. Mr. W. C. Parker, area general manager of the Board, on behalf of the management and workers, presented him with an oil painting.

Mr. G. W. ALEXANDER, Mr. W. MESSER, and Mr. G. W. DAVIDSON have been appointed directors of the Rhymney Engineering Company, Limited, which is owned jointly by Powell Duffryn, Limited, and International Combustion (Holdings), Limited.

Dr. HAROLD HARTLEY, C.B.E., chairman of Radiation, Limited, Stratford Place, London, W.1, will, at his own request, relinquish this office on December 31. His successor will be the present deputy chairman, Mr. W. DONALD KING. Dr. Hartley will retain his directorship of the company.

IT IS ANNOUNCED by Birlec, Limited, the furnace manufacturing company within the AEI group, that Mr. P. F. HANCOCK, research manager, Mr. A. E. PICKLES, manager of the induction heating division, and Mr. J. F. ROSS, works manager, have been appointed directors of the company.

Mr. J. A. HUNT, general manager of the Hymatic Engineering Company, Limited, and Mr. G. A. DURANT, supplies manager of the British Motor Corporation, and a local director of the Austin Motor Company, Limited, have been elected to the Council of the Birmingham Chamber of Commerce.

STEEL COMPANY OF WALES, LIMITED, announce the appointment of two assistant general managers in their steel division: Mr. R. W. EVANS (operations) and Mr. I. S. SCOTT-MAXWELL (engineering and development). Mr. Evans was formerly melting shops' superintendent, and Mr. I. S. Scott-Maxwell, chief engineer.

Mr. P. J. C. BOVILL, an assistant managing director of Newton Chambers & Company, Limited, has accepted an invitation to join the board of the Wellman Smith Owen Engineering Corporation, Limited. For a number of years there has been a close association between the two companies.

Mr. W. D. PUGH, managing director of the English Steel Corporation, Limited, has been appointed deputy chairman of the Darlington Forge, Limited, a subsidiary; Mr. W. S. Scott is made managing director, and Dr. C. J. Dadswell a director. Mr. W. E. A. Redfearn has been appointed assistant managing director of the English Steel Forge and Engineering Corporation, Limited.

Mr. JAMES ROBERTSON, who has completed 50 years' continuous service with Glenfield & Kennedy, Limited, Kilmarnock, was presented, last week, with gifts for himself and Mrs. Robertson from the male members of the drawing office staff. He already has the firm's long-service medal, and is only the third draughtsman in the long history of the firm to complete 50 years' continuous service in the drawing office.

Mr. F. W. SMITH is retiring on December 31, from the position of chairman and managing director of Dilworth & Carr, Limited, engineers and ironfounders, of Preston (subsidiary of United Glass Bottle Manufacturers, Limited). He will have completed 50 years' service with the company, 41 as managing director. Mr. Smith joined the Institute of British Foundrymen in 1932, attached to the Lancashire branch.

Mr. FRANK BROCKHOUSE, deputy chairman of J. Brockhouse & Company, Limited, West Bromwich, is retiring from the board of directors on account of age. He joined the company in 1888 and became a director in 1918, thus serving a total of 67 years, including 37 years on the board. He has seen the company grow from an organization employing 11 people to the present size—with eight branches and 30 subsidiaries.

Mr. J. GRAY BUCHANAN has been associated with William Jacks & Company, Limited, metal merchants and importers and exporters of plant and equipment, during most of their 75 years of trading. For some years past he has been chairman of directors; he joined the Glasgow office of the company in 1886, and became manager and partner of the business, now based in London, in 1901. He is one of the oldest members of the London Metal Exchange.

IN CONNECTION with the amalgamation of the Triplex Foundry Company, Limited, and the Great Bridge Foundry Company, Limited, Mr. W. H. L. HARRISON, managing director of the latter company, has agreed to join the board of Triplex in the capacity of chairman and managing director. Mr. J. W. and Mr. C. P. HORRELL will also act as managing directors. Mr. F. H. BENNETT will remain on the board, which is being further strengthened by the appointment of Mr. W. DOUGLAS CLARK of West Bromwich.

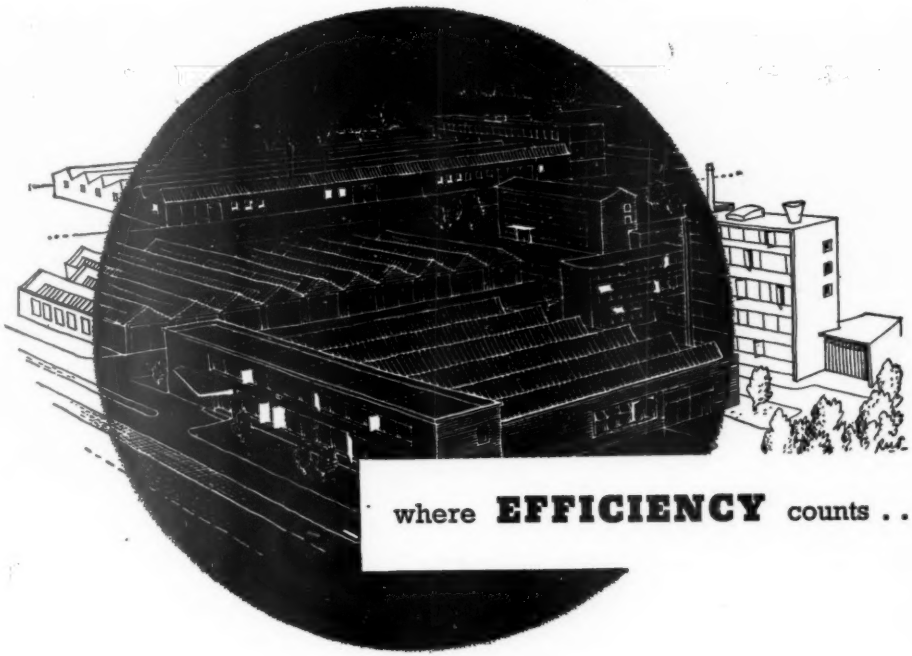
Obituary

Mr. J. S. A. WATKINSON, foundry manager at Wellworthy Piston Rings, Limited, Ringwood, for the past 11 years, died on November 26, at the age of 64 years.

Mr. G. C. TROWBRIDGE, a former managing director of Wickham, Limited, Coventry, has died aged 66. He joined Wickham's at Coventry in 1944, and became managing director in 1947, relinquishing the position last year owing to ill-health. He was a member of the Institute of Mechanical Engineers and of the Institution of Production Engineers.

SINCE 1952, Mr. Kenneth Gordon, who died on November 29, at the age of 57, had been Director-General of Ordnance Factories under the Ministry of Supply. He was a former joint managing director of the Billingham division of Imperial Chemical Industries, Limited, and deputy managing director of Head Wrightson Processes, Limited.

Mr. P. S. BAYLISS, a former managing director of Bayliss, Jones & Bayliss, Limited, Wolverhampton, has died at the age of 74. Mr. Bayliss—a grandson of one of the founders of the firm—joined the company more than 40 years ago. He became a director in 1921, joint managing director in 1927, and retired in 1948. He was also for four years a director of the British Rollmakers Corporation and Bayliss Rolls, Limited.



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Raw Material Markets

Iron and Steel

Continuing expansion of pig-iron production is an imperative need. Pig-iron makers have been building up their stocks of raw materials and should soon be able to bring additional capacity into operation. This should give an impetus to the performance of both the steel plants and the foundries, which have been using considerable tonnages of foreign pig-iron. The needs of the users of high-phosphorus iron have been overtaken, and specifications for this grade can be promptly covered, but there is still a dearth of low-phosphorus and medium-phosphorus iron and quite considerable tonnages of basic iron of Russian manufacture are being imported.

Shortage of labour rather than of material is now the chief worry of the re-rolling industry. There is no lack of orders. All the mills have substantial rolling programmes and bookings include many export sales at prices in excess of the maximum schedules fixed for the home market. Unfortunately, scarcity of manpower is beginning to limit outputs. On the other hand, difficulties in relation to supplies of most descriptions of steel semis have been overcome. Good supplies of home-produced billets, blooms, and slabs are coming forward and there are reasonable tonnages of foreign material in reserve.

As 1955 draws towards its close all the rolling mills are working under intensified pressure to increase their outputs. At best, the arrears in deliveries at the end of the year will be considerable, but some reduction is possible and the need is urgent. Reconciliation of the conflicting claims of home industries and the export trade presents a further difficulty. Increased shipments of finished steel are jealously regarded by British consumers, who in some instances have to rely on imported steel bought at enhanced prices. It is a confused situation which does not admit of speedy clarification. All the works have big commitments for the first half of next year and for the time being have suspended acceptance of new business.

Non-ferrous Metals

The continued rise in the price of tin this year has raised the value from a low point of £681 per ton to over £810 a ton this week. The unusually strong market for tin in London, Singapore, and New York reflects a mixture of the good demand expected over the coming months, the abnormally low stock position, and unsettled political conditions in the Middle and Far East, while absorption of tin by the United States stockpile authorities continues. Three months metal is at its highest level since April, 1953, having also topped the £800 mark.

Zinc has also been an active market in London and New York. On Whittington Avenue it has reached its highest point this year, approaching the £100 a ton level. The rise may have been less dramatic than that of tin, but the advance would appear to be no less solid. The call is strong for g.o.b. metal and demand outstrips available supplies of special high-grade material. The outlook for 1956 is bright and the market is looking for a further rise in the US price. In that case there is, perhaps, a growing speculative element in the demand.

In lead a high price is required on the London Metal Exchange to attract lead to this country, rather than lose it to the US, as has been happening recently.

Copper, although active, has been an uninteresting market. Threats of a strike in Chile on Sunday moved the price higher, but an indefinite postponement of the stoppage caused the market to ease. Demand is expanding in the States and consumers are tending to cover their first quarter's requirements. From the Rhodesian Copperbelt comes the news that the Northern Rhodesia Chamber of Mines has agreed to arbitration on the African Mineworkers' Union's demand for a basic wage increase of 6s. 8d. a shift.

Official metal prices were as follow:—

COPPER, Standard—*Cash:* December 1, £384 to £385; December 2, £388 to £389; December 5, £386 to £387; December 6, £392 10s. to £393; December 7, £390 to £391.

Three Months: December 1, £374 to £375; December 2, £379 to £379 10s.; December 5, £375 to £376; December 6, £379 to £380; December 7, £379 to £380.

TIN, Standard—*Cash:* December 1, £788 to £789; December 2, £798 to £799; December 5, £805 to £806; December 6, £810 to £810 10s.; December 7, £809 to £810.

Three Months: December 1, £776 to £777; December 2, £782 to £783; December 5, £789 to £790; December 6, £799 to £801; December 7, £800 to £801.

LEAD—*First half December:* December 1, £109 15s. to £110; December 2, £110 5s. to £110 10s.; December 5, £110 10s. to £110 15s.; December 6, £110 15s. to £111 5s.; December 7, £111 5s. to £111 10s.

First half March: December 1, £109 5s. to £109 10s.; December 2, £109 10s. to £110; December 5, £110 to £110 5s.; December 6, £110 5s. to £110 10s.; December 7, £110 10s. to £110 15s.

ZINC—*First half December:* December 1, £95 to £95 10s.; December 2, £96 15s. to £97; December 5, £97 5s. to £97 15s.; December 6, £98 to £99; December 7, £98 15s. to £99.

First half March: December 1, £93 5s. to £93 10s.; December 2, £93 10s. to £93 15s.; December 5, £94 to £94 10s.; December 6, £94 10s. to £94 15s.; December 7, £94 15s. to £95.

CFA Supervisors' Course

The second of a number of short residential courses in foremanship sponsored by the Council of Ironfoundry Associations (14, Pall Mall, London, S.W.1) has been organized by their training officer, Mr. John Collett. It will be held at Tor Lodge, near Wolverhampton, from January 2 to 6. The programme covers the following subjects: "Structure of the Iron Industry"; "Foreman's Rôle in Industrial Relations"; "Foundry Safety and Good Housekeeping"; "Industrial Law"; "Work-study in the Foundry"; "Foundry Cost Control"; "Apprentice Training"; and "Human Aspects of Supervision"; it includes at least one outside visit. The fee for the course, including accommodation and all meals, is £8 8s., and applications to participate should be sent immediately to Mr. Collett at the address quoted above. (The first course was held most successfully at Tor Lodge, in September (*vide* JOURNAL, October 6, p. 395).)

Fire Detection. The Minerva Detector Company, Limited, Red Lion Street, Richmond, Surrey, have used a 12-page brochure to describe and illustrate a new system of fire detection based on nuclear physics. It operates through detecting the first trace of smoke from any smouldering material and only one piece of apparatus is needed for 1,000 sq. ft. of floor space. A claim is made that after an experience of over ten years no building protected by the Minerva system has ever been destroyed by fire. The brochure is available to readers on writing to Richmond.

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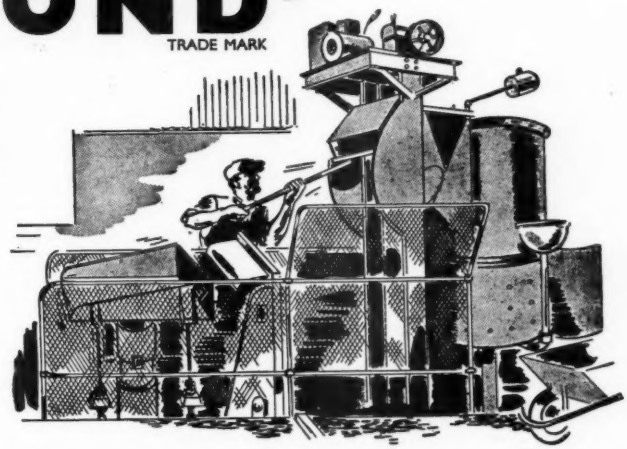

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Current Prices of Iron, Steel, and Non-ferrous Metals

(Delivered unless otherwise stated)

December 7, 1955

PIG-IRON

Foundry Iron.—No. 3 IRON, CLASS 2:—Middlesbrough, £17 1s. 0d.; Birmingham, £16 13s. 3d.

Low-phosphorus Iron.—Over 0.10 to 0.75 per cent. P, £18 12s. 9d., delivered Birmingham. Staffordshire blast-furnace low-phosphorus foundry iron (0.10 to 0.50 per cent. P, up to 3 per cent. Si), d/d within 60 miles of Stafford, £19 8s. 3d.

Scotch Iron.—No. 3 foundry, £19 5s. 6d., d/d Grangemouth.

Cylinder and Refined Irons.—North Zone, £21 3s. 0d.; South Zone, £21 5s. 0d.

Refined Malleable.—P, 0.10 per cent. max.—North Zone, £22 0s. 0d.; South Zone, £22 3s. 0d.

Hematite.—Si up to 2 per cent., S. & P. over 0.03 to 0.05 per cent. :—N.-E. of England (local iron), £19 5s.; Scotland (Scotch iron), £19 11s. 6d.; Sheffield, £20 12s. 0d.; Birmingham, £20 19s. 6d.; Wales (Welsh iron), £19 11s. 6d.

Basic Pig-iron.—£16 16s. 6d. all districts.

FERRO-ALLOYS

(Per ton unless otherwise stated, delivered)

Ferro-silicon (6-ton lots and over).—45 per cent. Si, nominal, scale 15s. per unit; 75 per cent. Si, nominal, scale 16s. per unit.

Ferro-vanadium.—50/60 per cent., 23s. 8d. to 25s. 0d. per lb. of V.

Ferro-molybdenum.—65/75 per cent., carbon-free, 11s. 0d. per lb. of Mo.

Ferro-titanium.—20/25 per cent., carbon-free, £230 0s. 0d.; 38/40 per cent., £279 0s. 0d.

Ferro-tungsten.—80/85 per cent., 17s. 6d. per lb. of W.

Tungsten Metal Powder.—98/99 per cent., 20s. 1d. per lb. of W.

Ferro-chrome (6-10 ton lots).—4/6 per cent. C, £88 10s. 0d. to £95 0s. 0d., basis 60 per cent. Cr, scale 28s. 0d. to 32s. 0d. per unit; over 6 per cent. C, £87 10s. 0d. to £93 0s. 0d., basis 60 per cent. Cr, scale 28s. 0d. to 32s. 0d. per unit; 2 per cent. C* 2s. 1d. per lb. Cr.; 1 per cent. C,* 2s. 1½d. per lb. Cr; 0.15 per cent. C,* 2s. 2½d. per lb. Cr; 0.10 per cent. C,* 2s. 2¾d. per lb. Cr; 0.06 per cent. C,* 2s. 3d. per lb. Cr.

Metallic Chromium.—98/99 per cent., 7s. 0d. to 7s. 6d. per lb.

Metallic Manganese.—93/95 per cent., carbon-free, £249 0s. 0d.; 96/98 per cent., £269 0s. 0d.

Ferro-columbium.—60/75 per cent., Nb + Ta, 28s. per lb., Nb. + Ta.

Ferro-manganese (home).—78 per cent., £54 10s. 0d.

SEMI-FINISHED STEEL

Re-rolling Billets, Blooms, and Slabs.—BASIC: Soft, u.t., £26 19s. 0d.; tested, 0.08 to 0.25 per cent. C, £27 19s. 0d.; hard (0.41 to 0.60 per cent. C), £29 5s. 6d.; silico-manganese, £37 12s. 6d.; free-cutting, £31 0s. 6d. SIEMENS MARTIN ACID: Up to 0.25 per cent. C, £34 12s. 0d.; silico-manganese, £36 12s. 6d.

Billets, Blooms, and Slabs for Forging and Stamping.—Basic, soft, up to 0.25 per cent. C, £32 11s. 0d.; basic, hard, over 0.41 up to 0.60 per cent., C, £33 13s. 6d.; acid, up to 0.25 per cent. C, £36 12s. 6d.

FINISHED STEEL

Heavy Plates and Sections.—Ship plates (N.-E. Coast), £33 1s. 6d.; boiler plates (N.-E. Coast), £35 11s. 6d.; floor plates (N.-E. Coast), £34 10s. 6d.; sectional material, N.-E. Coast, £30 19s. 6d.

Small Bars, Sheets, etc.—Rounds and squares, under 3 in., untested, £34 7s. 0d.; flats, 5 in. wide and under, £34 7s. 0d.; hoop and strip, £35 1s. 6d.; uncoated strip mill coils, hot rolled, under 3mm. to 12g., £36 5s. 0d.; black sheets (hand mill), 17/20 g., £46 13s. 6d.; galvanized corrugated sheets, 24 g., £58 11s. 0d.

Alloy Steel Bars.—1 in. dia. and up: Nickel, £58 0s. 3d.; nickel-chrome, £81 10s. 0d.; nickel-chrome-molybdenum, £92 7s. 6d.

NON-FERROUS METALS

Copper.—Cash, £390 0s. 0d. to £391 0s. 0d.; three months, £379 0s. 0d. to £380 0s. 0d.; settlement, £391 0s. 0d.

Copper Tubes, etc.—Solid-drawn tubes, 3s. 8½d. per lb.; rods, 434s. 3d. per cwt. basis; 20 s.w.g., 467s. 6d. per cwt.

Tin.—Cash, £809 0s. 0d. to £810 0s. 0d.; three months, £800 0s. 0d. to £801 0s. 0d.; settlement, £810 0s. 0d.

Lead (Refined Pig).—Second half November, £111 5s. 0d. to £111 10s. 0d.; second half February, £110 10s. 0d. to £110 15s. 0d.

Zinc.—Second half November, £98 15s. 0d. to £99 0s 0d.; second half February, £94 15s. 0d. to £95 0s. 0d.

Zinc Sheets, etc.—Sheets, 15 g. and thicker, all English destinations, £129 0s. 0d.; rolled zinc (boiler plates), all English destinations, £126 15s. 0d.; zinc oxide (Red Seal), d/d buyers' premises, £109 0s. 0d.

Brass Tubes, etc.—Solid-drawn tubes, 2s. 11¼d. per lb.; rods, drawn, 3s. 8¼d.; sheets to 10 w.g., 368s. 9d. per cwt.; wire, 3s. 6¼d.; rolled metal, 354s. 6d. per cwt.

Brass (Brazing).—BS1400, B3 (65/35), £229; B6 (85/15), —; BS249, £238.

Brass (High Tensile).—BS1400, HTB1 (30 tons), £285; HTB2 (38 tons), £290 ; HTB3 (48 tons), —.

Gunmetal.—RCH, 3/4 per cent. tin, —; BS1400, LG2 (85/5/5/5), £328; LG3 (86/7/5/2), £338; G1 (88/10/2/½), £403; (88/10/2/1), £399.

Phosphor Bronze.—BS1400, PB1 (AID released), £421 per ton.

Phosphor Bronze Strip, etc.—Strip, 514s. 0d. per cwt.; sheets to 10 w.g., 537s. 6d. per cwt.; wire, 5s. 3½d. per lb.; rods, 4s. 7½d.; tubes, 4s. 5½d.; chill cast bars: solids 4s. 7½d., cored 4s. 8½d. (CHARLES CLIFFORD, LIMITED).

Nickel Silver, etc.—Rolled metal, 3 in. to 9 in. wide × 0.056, 4s. 5½d. per lb.; round wire, 10g. in coils (10 per cent.), 4s. 10d.; special quality turning rod, 10 per cent., ½ in. dia., in straight lengths, 4s. 9d. All prices are net.

Other Metals.—Magnesium, ingots, 2s. 4d. per lb. Antimony, English, 99 per cent.. £210 0s. 0d. Quicksilver, ex-warehouse, £89 10s. 0d. to £90 0s. 0d. Nickel, £519 0s. 0d Aluminium, ingots, £171 0s. 0d.; aluminium bronze (BS1400), AB1, £372 ; AB2, £381. Solder, brazing, BS1945. 3s. 1d. lb. granulated, 3s. 4½d. lb.

* Average 68-70 per cent.